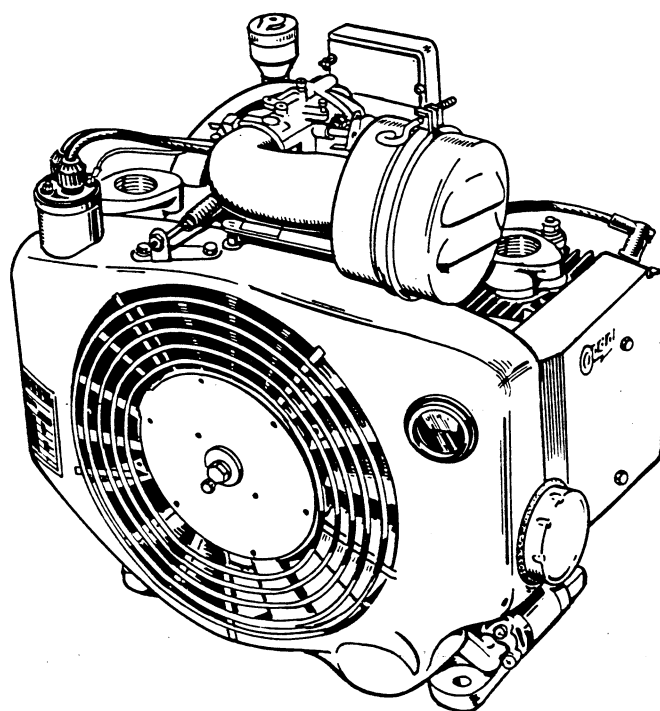


OPERATORS/SERVICE MANUAL AND PARTS CATALOG

SERIES NH INDUSTRIAL ENGINES



ONAN INDUSTRIAL ENGINES

NH SERIES

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GENERAL INFORMATION

This manual contains installation and operation instructions as well as information required for proper maintenance, adjustment and repair of the engine. Since the first and most important part of repair work is the correct diagnosis of the trouble, a trouble-shooting chart is included.

Study and follow the instructions carefully. Proper service and maintenance will result in longer engine life and better performance.

How to interpret MODEL and SPEC NO.

NH	-	MS	/	375	C
1		2		3	4

1. Factory code for general identification purposes.
2. Specific Type:
 - S* - *MANUAL* starting with stub shaft power take off.
 - MS* - *ELECTRIC* starting with stub shaft, starter and generator.
3. Factory code for optional equipment supplied.
4. Specification (Spec. Letter) advances with factory production modification.



MANUFACTURER'S WARRANTY

Onan warrants, to the original user, that each product of its manufacture is free from defects in material and factory workmanship if properly installed, serviced and operated under normal conditions according to Onan's instructions.

Onan will, under this warranty, repair or replace, as Onan may elect, any part which on examination shall disclose to Onan's satisfaction to have been defective in material and workmanship; provided that such part shall be returned to Onan's factory or one of its Authorized Service Stations, transportation charges prepaid, not later than one (1) year after the product is first placed in service. Such defective part will be repaired or replaced free of charge, including labor (in accordance with rates approved by Onan) during the stated one (1) year coverage under this warranty.

THIS WARRANTY AND ONAN'S OBLIGATION THEREUNDER IS IN LIEU OF ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ALL OTHER OBLIGATIONS OR LIABILITIES, INCLUDING LIABILITY FOR INCIDENTAL AND CONSEQUENTIAL DAMAGE.

No person is authorized to give any other warranty or to assume any other liability on Onan's behalf unless made or assumed in writing by an Officer of Onan, and no person is authorized to give any warranty or to assume any liabilities on the Seller's behalf unless made or assumed in writing by such Seller.

ONAN

1400 73RD AVENUE N.E. • MINNEAPOLIS, MINNESOTA 55422

SPECIFICATIONS

	NH-S/1	NH-MS/1
Nominal Dimensions		
Height	18-1/2	20-5/16
Width	20-9/16	20-9/16
Length	15-1/4	15-1/4
Number of Cylinders	2	
Displacement (cubic inch)	60	
Cylinder Bore	3.562	
Piston Stroke	3.00 in.	
Horsepower	25 BHP @ 3600 rpm	
Compression Ratio	7.0:1	
Ventilation Required (cfm @ 3600 rpm)	1250	
Oil Capacity (with filter)	3-1/2 qt.	4 qt.
Oil Filter	1/2 quart, spin-on	
Starting	Manual	Electric
Ignition	Magneto*	Battery
Combustion Air (cfm @ 3600 rpm)	64	
Fuel	Gasoline	
Fuel Pump	Diaphragm, 4 ft. lift	
Governor	Cam gear driven, mechanical flyball	

* With automatic spark advance.

DIMENSIONS AND CLEARANCES

All clearances given at room temperature of 70°F.

	Minimum	Maximum
Valve Tappet Clearance		
Intake		0.003*
Exhaust		0.010*
Valve Stem in Guide – Intake	0.001 "	0.0025 "
Valve Stem in Guide – Exhaust	0.0025 "	0.004 "
Valve Spring Length		
Free Length		1.662 "
Compressed Length		1.375 "
Valve Spring Tension (lb)		
Open	71	79
Closed	38	42
Valve Seat Bore Diameter		
Intake	1.5645 "	1.5655 "
Exhaust	1.2510 "	1.2520 "
Valve Seat Diameter		
Intake	1.569 "	1.570 "
Exhaust	1.255 "	1.256 "
Valve Stem Diameter		
Intake	0.3425 "	0.3430 "
Exhaust	0.3410 "	0.3415 "
Valve Guide Diameter (I.D.)	0.344 "	0.346 "
Valve Lifter Diameter	0.7475 "	0.7480 "
Valve Lifter Bore	0.7500 "	0.7515 "
Valve Seat Interference Width	1/32 "	3/64 "
Valve Face Angle		44°
Valve Seat Angle		45°
Valve Interference Angle		1°
Crankshaft Main Bearing	0.0025 "	0.0038 "
Crankshaft End Play	0.005 "	0.009 "
Camshaft Bearing	0.0015 "	0.003 "
Camshaft End Play	0.003 "	—
Camshaft Lift		0.300 "
Camshaft Bearing Diameter	1.3760 "	1.3770 "
Camshaft Journal Diameter	1.3740 "	1.3745 "
Rod Bearing (Forged Rod)	0.0005 "	0.0023 "
Connecting Rod End Play (Ductile Iron)	0.002 "	0.016 "
Timing Gear Backlash	0.002 "	0.003 "
Oil Pump Gear Backlash	0.002 "	0.005 "
Piston to Cylinder, Strut Type (Measured below oil-controlling ring – 90° from pin) Clearance	0.0015 "	0.0035 "
Piston Pin Diameter	0.7500 "	0.7502 "
Piston Pin in Piston	Thumb Push Fit	
Piston Pin in Rod	0.0001 "	0.0005 "
Piston Ring Groove Width		
Top 1	0.0955 "	0.0965 "
Top 2	0.0955 "	0.0965 "
Top 3	0.1880 "	0.1890 "

* ±0.001 "

Piston Ring Gap in Cylinder	0.010"	0.020"
Piston Ring Side Clearance (Top compression ring only)		0.006"
Breaker Point Gap (Full Separation)		0.020"
Spark Plug Gap – For Gasoline Fuel		0.025"
Crankshaft Main Bearing Journal – Standard Size	1.9992"	2.000"
Main Bearing Diameter	2.0015"	2.0040"
Main Bearing Clearance	0.0015"	0.0043"
Crankshaft Rod Bearing Journal – Standard Size	1.6252"	1.6260"
Cylinder Bore – Standard Size	3.5625"	3.5635"
Ignition Timing Advance (without Automatic Spark Advance)		22°BTC –
Stopped (With Automatic Spark Advance)		3°ATC
Running (With Automatic Spark Advance)		22°BTC
Magneto Pole Shoe Air Gap	0.010"	0.015"

ASSEMBLY TORQUES AND SPECIAL TOOLS

TORQUES

Assembly torques as given here require the use of a torque wrench. These assembly torques will assure proper tightness without danger of stripping the threads. If a torque wrench is not available, you will have to estimate the degree of tightness necessary for the stud, nut or screw being installed and tighten accordingly. Be careful not to strip the threads. Check all studs, nuts and screws often with the engine cold. Tighten as needed to prevent them from working loose.

TORQUE SPECIFICATIONS	FT.-LB.
Cylinder Head Nuts	17-19
Rear Bearing Plate	25-27
Connecting Rod Bolt	27-29
Flywheel Capscrew	35-40
Starter Mounting Bracket to	
Oil Base Screws	43-48
Magneto Stator Screws	8-10
Gear Case Cover	8-10
Oil Pump	7-9
Other 3/8 Cylinder Block Nuts	18-23
Manifold Screws	16-23
Rotor to Flywheel Screws	5
Fuel Pump Mounting Screws	5-6

SPECIAL TOOLS

These tools are available from ONAN to aid service and repair work.

Crankshaft Gear Pulling Ring	420A248
Flywheel Puller	420A100
Combination Bearing Remover,	
Main and Cam	420A325
Combination Bearing Driver,	
Main and Cam	420B324
Valve Guide Driver	420A300
Valve Seat Driver	420A308
Valve Seat Staker	
Intake	420A309
Exhaust	420A310
Valve Seat Cutter	420A311
Oil Seal Guide and Driver	
Bearing Plate	420B181
Gear Cover	420B313
Timing Advance Mech. Cover Driver	420A296

TROUBLE																				GASOLINE ENGINE TROUBLESHOOTING GUIDE										
Backfire at Carburetor	Bearing Wear	Black E-Exhaust	Blue Exhaust	Burned Valves	Connecting Rod Wear	Crankshaft Slowly	Cylinder Wear	Engine Stops	Failure to Start	Governor Hunting	High Oil Pressure	Low Oil Pressure	Loss of Coolant (Water Cooled)	Misfiring	Overheating (Air Cooled)	Overheating (Water Cooled)	Piston Wear	Poor Compression	Ring Wear	Sticking Valves	CAUSE									
STARTING SYSTEM																														
																					Loose or Corroded Battery Connection									
																					Low or Discharged Battery									
																					Faulty Starter									
																					Faulty Start Solenoid									
IGNITION SYSTEM																														
																					Ignition Timing Wrong									
																					Wrong Spark Plug Gap									
																					Worn Points or Improper Gap Setting									
																					Bad Ignition Coil or Condenser									
																					Faulty Spark Plug Wires									
FUEL SYSTEM																														
																					Out of Fuel - Check									
																					Lean Fuel Mixture - Readjust									
																					Rich Fuel Mixture or Choke Stuck									
																					Engine Flooded									
																					Poor Quality Fuel									
																					Dirty Carburetor									
																					Dirty Air Cleaner									
																					Dirty Fuel Filter									
																					Defective Fuel Pump									
INTERNAL ENGINE																														
																					Wrong Valve Clearance									
																					Broken Valve Spring									
																					Valve or Valve Seal Leaking									
																					Piston Rings Worn or Broken									
																					Wrong Bearing Clearance									
COOLING SYSTEM (AIR COOLED)																														
																					Poor Air Circulation									
																					Dirty or Oily Cooling Fins									
																					Blown Head Gasket									
COOLING SYSTEM (WATER COOLED)																														
																					Insufficient Coolant									
																					Faulty Thermostat									
																					Worn Water Pump or Pump Seal									
																					Water Passages Restricted									
																					Defective Gaskets									
																					Blown Head Gasket									
LUBRICATION SYSTEM																														
																					Defective Oil Gauge									
																					Relief Valve Stuck									
																					Faulty Oil Pump									
																					Dirty Oil or Filter									
																					Oil Too Light or Diluted									
																					Oil Level Low									
																					Oil Too Heavy									
																					Dirty Crankcase Breather Valve									
THROTTLE AND GOVERNOR																														
																					Linkage Out of Adjustment									
																					Linkage Worn or Disconnected									
																					Governor Spring Sensitivity Too Great									
																					Linkage Binding									

INSTALLATION

The type of installation can affect the life of the engine, the cost of operation and the frequency of necessary service. Plan the installation carefully to ensure the best performance.

Because of the great variety of uses, and the many variations of the engine, these installation instructions are typical or general in nature. Use the installation recommendations given as a general guide, improvising or altering as necessary.

MOUNTING

There are several acceptable methods of mounting the engine. Among factors to be considered are: location, method of coupling the engine to the load, type of foundation or support, etc. The engine should be mounted on a level surface if possible. Maximum operation angle is 15° sideways, 30° front to rear tilt. If the engine is to operate at an angle, be sure to re-mark the oil level indicator to compensate for the tilt.

VENTILATION

The engine must be provided with a supply of fresh air for cooling and for combustion.

Pressure Cooled Engine: Position the air inlet opening directly in front of the engine and as close to the engine blower wheel as possible. The area of the inlet should be not less than 80 square inches. If louvers or grill work are used, increase the area to compensate for the reduced air flow. Provide extra ventilation if the driven load generates heat during operation.

The heated air outlet must allow the heated air to escape freely and prevent recirculation with the cooling air. A duct between the compartment air inlet and the engine blower housing may be necessary. Locate the air outlet opposite the intake or at least at a 90° angle. The area of the outlet should be at least 15% larger than that of the inlet. Allow sufficient room on all sides to permit access for servicing.

Vacu-Flo Cooled Engine: The Vacu-Flo installation permits greater freedom in choice of locating the air inlet and outlet openings and permits the use of a compartment only slightly larger than the unit itself.

The area of the air inlet opening must be not less than 140 square inches. If a filter, grille or louvers are used, the inlet opening must be increased accordingly. The air outlet opening should be located as

close to the engine as is practical. If air ducts are used, the duct can be the same size as the engine air outlet, 1-1/8 x 8". Increase the duct area by 30% if; the duct length exceeds five feet, or if using up to two 90° radius (not square) elbows.

On electric start engines the air outlet scroll may be positioned either up or to the right.

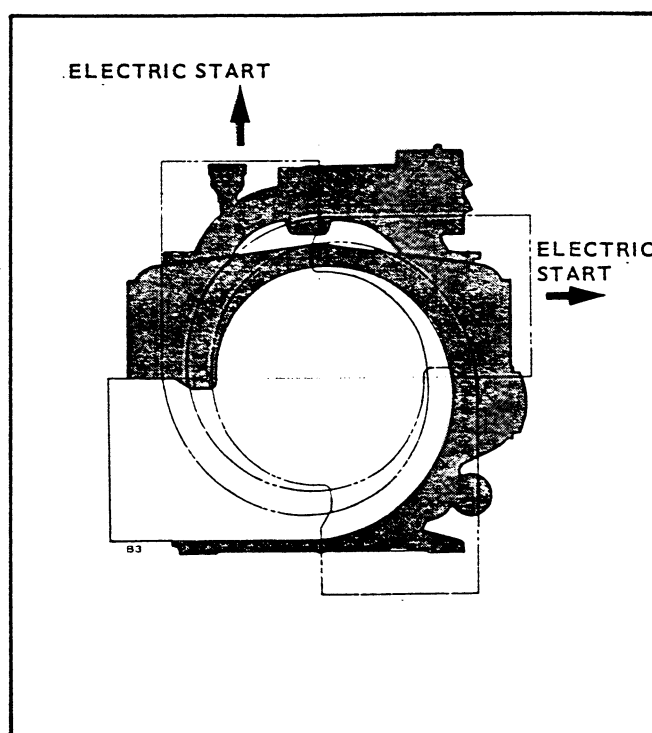


FIGURE 1. AIR OUTLET POSITIONS

Provide a short canvas section between the engine air outlet and the external duct or opening to absorb vibration. If operation in cold weather is likely, the installation of a shutter in the air outlet of Vacu-Flo units is advisable. Cold weather can cause overcooling if the air flow is not regulated.

Open Air Installation: For installations where the engine is operated outside, ventilation will be no problem. However, in protecting the engine from the elements, see that nothing obstructs the flow of air around the engine.

EXHAUST

Pipe exhaust gas outside enclosure. Use a length of flexible tubing between the plant exhaust outlet and any rigid piping to absorb engine vibration. Shield the line if it passes through a combustible wall or partition. If turns are necessary, use sweeping type (long radius) elbows. Increase one pipe size (from manifold outlet size) for each additional ten feet in length. Locate the outlet away from the air intake.

CARBURETOR AIR INTAKE

Proper engine efficiency depends upon a supply of fresh air to the carburetor. Under special conditions, it may be necessary to move the air cleaner off the engine, using a longer connection hose as necessary. For extremely dusty or dirty conditions, install a special heavy duty air cleaner.

FUEL SYSTEM

The engine uses a diaphragm type fuel pump. The fuel pump has a 1/8" pipe thread inlet, fitted with a 1/4" inverted flare tube fitting. If a solid wall line is used, form a loop in the line, or install a section of flexible fuel hose, to absorb vibration. If a line with a pipe thread end is used, remove the flare type fitting from the fuel pump inlet.

The installation of a fuel filter between the fuel tank and the fuel pump is recommended. The fuel filter can be fitted with a shutoff valve and should be easily accessible for cleaning.

CONNECTING TO THE LOAD

The dimensions of various power takeoff shafts are as follows:

SHAFT	DIAMETER	LENGTH	KEY SIZE
STD	1 7/16	3 1/16	3/8
Rockford Clutch	1 7/16	3 1/2	3/8
Gear Reduction	1 1/4	2 3/4	1/4

Belt Drive: V-belts are preferable to flat belts. Consult a reliable belting supplier for recommendations regarding size of pulleys, number of belts, etc. required. A typical belt drive installation is shown in Figure 2.

Comply with the following installation requirements:

1. The shafts of the engine and the load must be parallel with each other.
2. The pulleys of the engine and the load must be in alignment.
3. Mount the engine pulleys as close to the engine as possible.
4. If the installation permits, belts should run horizontally.
5. Some method of disconnecting the load for starting is recommended. If a clutch is not used, a belt-

tightener idler arrangement can be used.

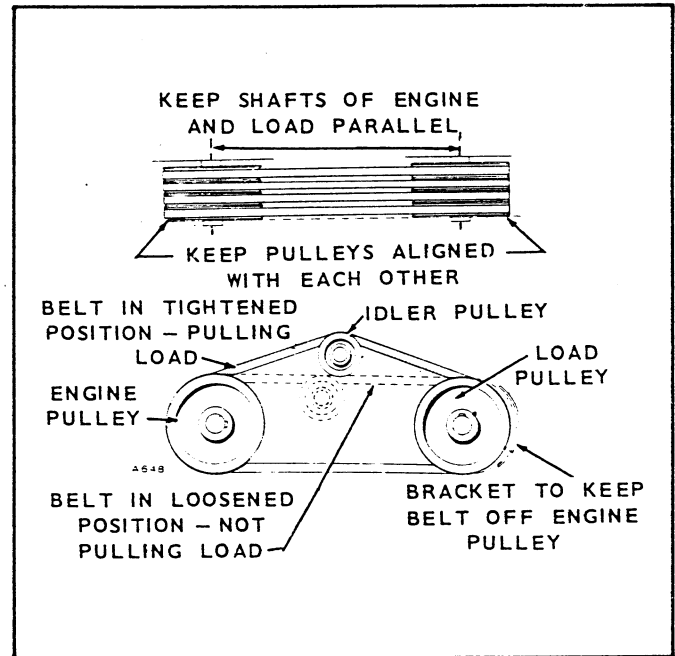


FIGURE 2. DRIVE BELT INSTALLATION

Flexible Coupling: If a flexible coupling engine-to-load drive is used, the load shaft must be in line and centered with the engine shaft (Figure 3).

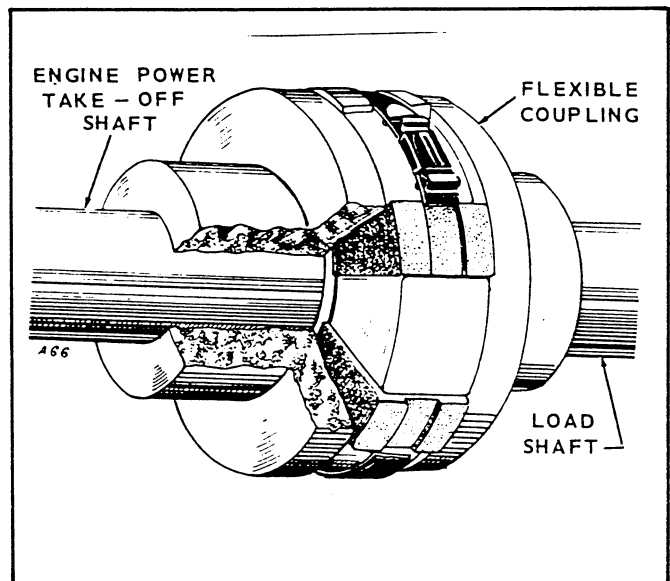


FIGURE 3. FLEXIBLE COUPLING

Reduction Gear Drive: Reduction gear drives are mounted at the factory (when ordered). The method of connecting the load is the same as when connecting directly to the engine shaft.

Clutch Installation: A Rockford Clutch can be installed at the factory or in the field. Install the clutch according to the following instructions and Figure 4.

Provide room for the clutch adapter casting by plugging the wet holes with a 3/8-16 x 1/2" slotted headless set screw. Apply sealing compound to the threads and install screw flush with the cylinder block.

Drill a 13/64" hole (or filed slot) in the crankshaft for the clutch set screw. Locate center of hole 11/32" from the end and directly opposite the keyway in the crankshaft.

Install the clutch adapter, with drain slot downward, using two cap screws 3/8-16 x 2" on the lower and one cap screw 3/8-16 x 1-3/4" on the upper #2 cylinder side (cylinder nearer clutch). Install the 3/8 x 3-7/8" stud through the adapter into the engine block upper remaining hole. Use a lock washer on each assembly screw. Use a flat washer and a lock washer under the stud nut.

Install the crankshaft key. Remove the clutch set screw. Install the clutch assembly (less housing) to the crankshaft, driving it on carefully with a soft-faced hammer until set screw hole is aligned. Install set screw to bottom in crankshaft hole, then back it out one full turn. Tighten clutch retaining screws until clutch is clamped securely to crankshaft. Lock the screws and tighten the set screw.

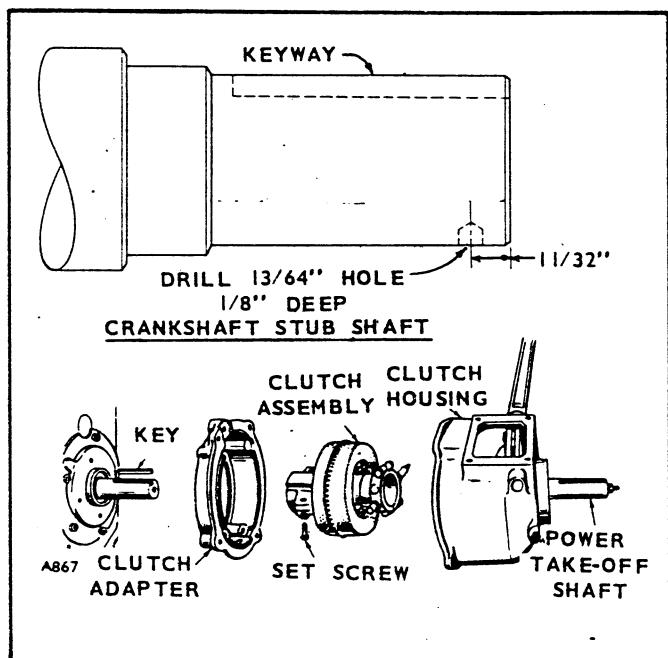


FIGURE 4. CLUTCH INSTALLATION

Apply grease to splined power takeoff shaft. Position the clutch throw-out collar to align the grease fitting with the hole in the housing (#1 cylinder side, horizontal). Pull the throw-out collar outward to remove tension.

Install the clutch housing so that the clutch throw-out fork engages the throw-out collar. Be sure the serrated shaft is properly meshed with the clutch plate. Use two cap screws 7/16-14 x 2" on the lower and one cap screw 7/16-14 x 1-3/4" on the upper #2 cylinder side. Install the stud washer and nut. Lubricate the two grease fittings just until grease appears.

BATTERY CONNECTIONS (Engines with Automotive Type Separate Starter)

Connect the 12 volt battery positive cable to the engine start switch terminal. Connect the battery negative cable to the ground point on the engine oil base (Figure 5).

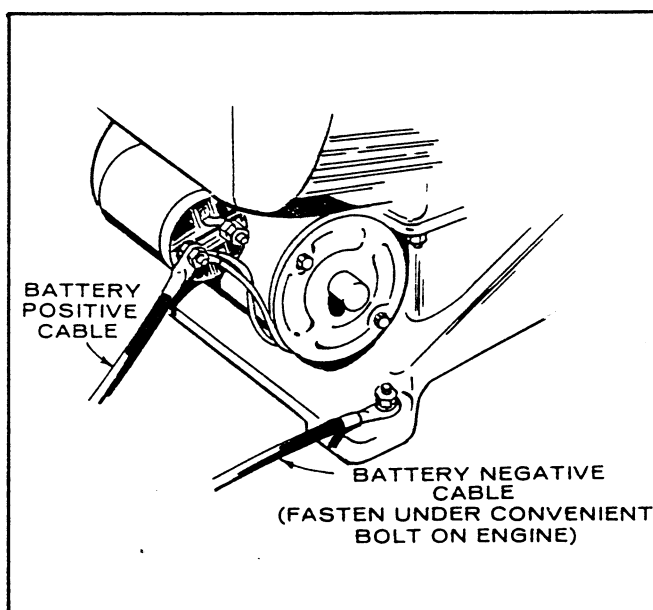


FIGURE 5. BATTERY CONNECTIONS

OPERATION

BEFORE STARTING

Be sure the crankcase has been filled to the FULL mark with an American Petroleum Institute (API) designation SE oil of the viscosity recommended on the nameplate. If the (API) SE oil is not available an SD or SD/CC oil may be used.

Fill the fuel tank with a good grade of fresh nonleaded automotive gasoline if the engine is new. If a leaded gasoline has been used for more than a few hours the engine head should be removed and all lead deposits cleaned out before using the lead free fuel. Do not fill the tank with the engine running but do allow expansion space in the tank. To assure fuel supply make sure the fuel line valve is opened and operate the primer.

STARTING (Electric Start)

1. Snap the ignition switch to its ON position.
2. Push the START button to crank the engine.

STARTING (Manual Start)

1. Close the choke about three quarters of the way or as necessary according to temperature conditions.
2. Pull the start rope with a fast steady pull to crank the engine. Do not jerk.

If the engine fails to start at first attempt, inhibitor oil used at the factory may have fouled the spark plugs. Remove the plugs, clean in suitable solvent, dry thoroughly and install. Heavy exhaust smoke when the engine is first started is normal and is caused by inhibitor oil.

APPLYING LOAD

When applying the load to a new or reconditioned engine, it should be applied gradually in about four steps; each step of not less than 30 minutes running time. Start with 1/4 load, then 1/2, 3/4 and full load.

BATTERY CHARGING

The battery charge rate is controlled by a charge regulator. The regulator is set to allow the proper rate of charge at operating speed. Do not attempt to change this adjustment.

STOPPING THE ENGINE

Disconnect all load before stopping the engine, where practicable. Engines equipped with battery ignition are stopped by setting the ignition switch to the OFF position.

Engines equipped with magneto ignition are stopped by pushing in firmly on the STOP button, located on

the blower housing, until the engine completely stops running.

HIGH TEMPERATURES

1. See that nothing obstructs air flow to and from the engine.
2. Keep cooling fins clean. Air housing should be properly installed and undamaged.

LOW TEMPERATURES

1. Use correct SAE No. oil for temperature conditions. Change oil only when engine is warm.
2. Use fresh fuel. Protect against moisture condensation.
3. Keep fuel system clean and batteries in a well charged condition.
4. Partially restrict cool air flow, but use care to avoid overheating.

DUST AND DIRT

1. Keep unit clean. Keep cooling system clean.
2. Service air cleaner as frequently as required.
3. Change crankcase oil every 100 hours. Change oil filter every 200 hours.
4. Keep oil and gasoline in dust tight containers.
5. Keep governor linkage clean.

OUT-OF-SERVICE PROTECTION

Protect an engine to be out-of-service for more than 30 days as follows:

1. Run unit until thoroughly warm.
2. Turn off fuel supply and run until unit stops.
3. Drain oil from oil base while still warm. Refill and attach a warning tag stating oil viscosity used.
4. Remove each spark plug. Pour one ounce (two tablespoons) of rust inhibitor (or SAE #50 oil) into each cylinder. Crank engine slowly (by hand) several times. Install spark plug.
5. Service air cleaner.
6. Clean governor linkage and protect by wrapping with a clean cloth.
7. Plug exhaust outlet to prevent entrance of moisture, dirt, bugs, etc.
8. Wipe entire unit. Coat rustable parts with a light film of grease or oil.
9. Provide a suitable cover for the entire unit.
10. If battery is used, disconnect and follow standard battery storage procedure.

SERVICE AND MAINTENANCE

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS						
	8	50	100	200	500	1000	5000
Inspect Engine Generally	x						
Check Fuel Supply	x						
Check Oil Level	x						
Clean Governor Linkage		x					
Service Air Cleaner			x				
Change Crankcase Oil			x				
Check Breaker Points			x				
Check Battery Electrolyte Level			x				
Clean Fuel Filter			x				
Check Spark Plugs			x				
Remove Deposits in Combustion Chamber					x		
Replace Oil Filter				x			
Check Valve Clearance					x		
Replace Air Cleaner Element					x		
Inspect Valves, Grind If Necessary						x	
Complete Reconditioning							x
Reduction Gear Drive			x				

PERIODIC MAINTENANCE SCHEDULE

Regularly scheduled maintenance is the key to lower operating costs and longer service life for the unit. The above schedule can be used as a guide. However, actual operating conditions under which a unit is run should be the determining factor in establishing a maintenance schedule. When operating in very dusty or dirty conditions, some of the service periods may have to be reduced. Check the condition of the crankcase oil, the filters, etc. frequently until the proper service time periods can be established.

When any abnormalities occur in operation — unusual noises from engine or accessories, loss of power, overheating, etc. — contact your ONAN dealer.

CRANKCASE OIL

When changing oil fill the crankcase to the FULL mark with a good quality (API) SE oil of the viscosity specified on the nameplate. If SE oil is not available (API) SD or SD/CC oil may be used.

NOTE: If oils with these designations are not yet available, use an oil with the API designation MS, MS/DG or MS/DM which has passed all the Automotive Manufacturer's Sequence Tests and the MIL-L-2104B Tests. Don't use an oil with the API designation DS.

When adding oil between changes, use oil identical to the oil in the crankcase in API designation, SAE viscosity and brand.

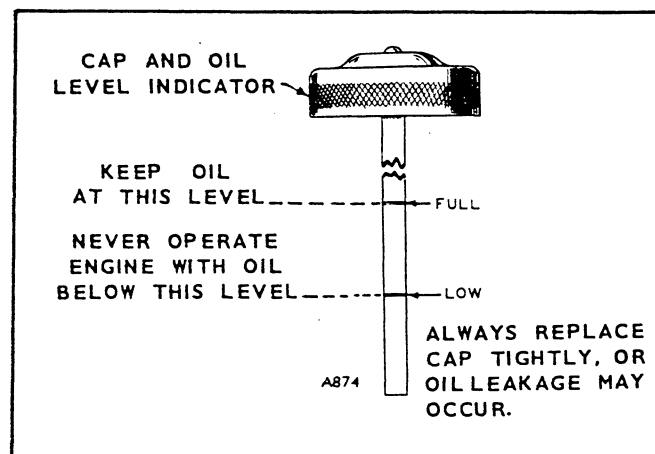


FIGURE 6. OIL LEVEL INDICATOR

Oil consumption may be higher with a multigrade oil than with a single grade oil if both oils have comparable viscosities at 210°F. Therefore, single grade oils are generally more desirable, unless anticipating a wide range of temperatures. Use the proper grade oil for the expected conditions.

TEMPERATURE	GRADE
Below 0°	5W
0° to 30°	10W
30° to 90°	30
Above 90°	50

Check oil level daily. Change oil every 100 hours under normal operating conditions. When operating in extremely dusty or dirty conditions, change oil every 50 hours. (See Figure 6).

Change the crankcase oil filter every 200 hours. Remove the filter by turning counterclockwise, using a filter wrench. See Figure 7. It is advisable to wipe dry the drip pan located below the filter. Coat rubber gasket on filter with film of oil before installing. Install the filter tight plus 1/4 to 1/2 turn.

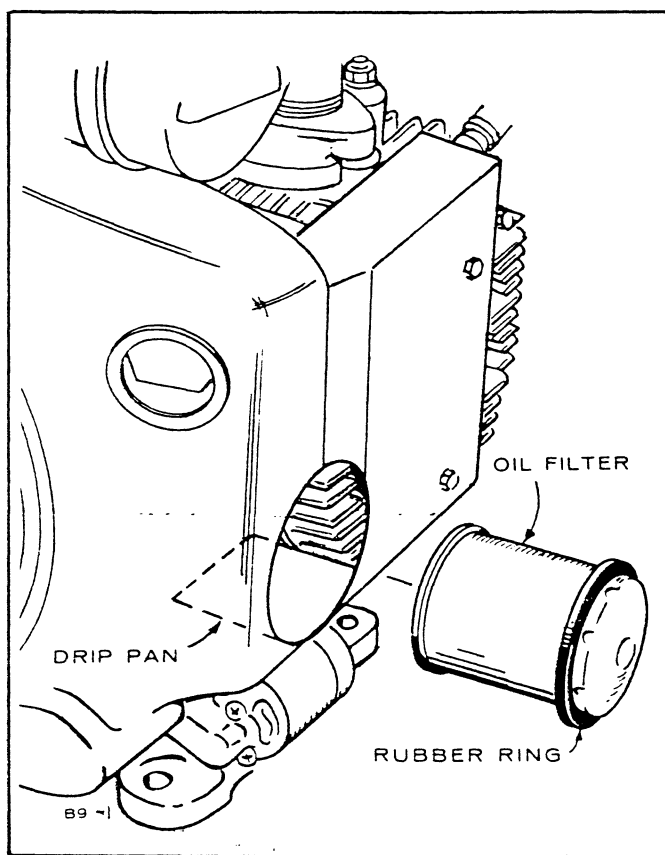


FIGURE 7. OIL FILTER LOCATION

CRANKCASE BREATHER

The engine is equipped with a ball check valve for maintaining crankcase vacuum. No maintenance is generally required. Should the crankcase become

pressurized, as evidenced by oil leaks at the seals or around the cap of the oil level indicator, clean baffle in suitable solvent. See Figure 8.

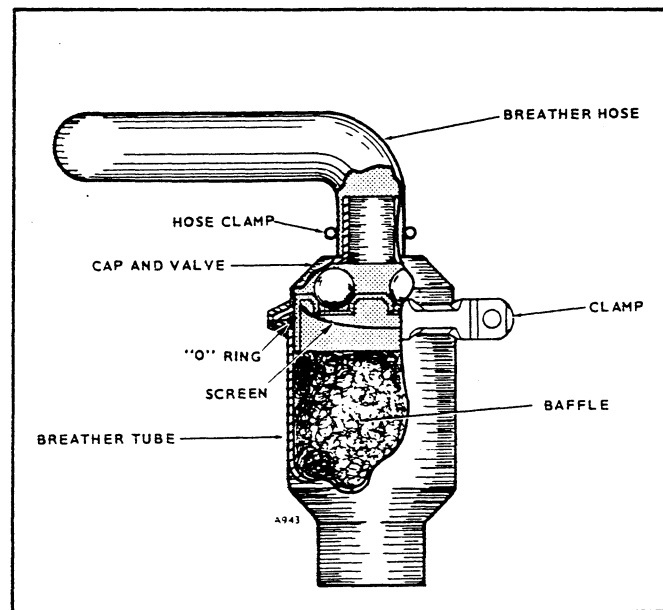


FIGURE 8. CRANKCASE BREATHER

AIR CLEANER

Proper maintenance of the air cleaner (Figure 9) is extremely important. Negligence of regular routine maintenance will result in reduced engine life.

Allowing the element to become plugged with dirt will restrict the intake of air into the engine. Inspect the element for tiny holes or tears which would permit particles of dust or dirt to enter the engine.

Remove the paper element every 100 operating hours and clean by tapping against a flat, solid object to loosen dust and dirt accumulation. The element can

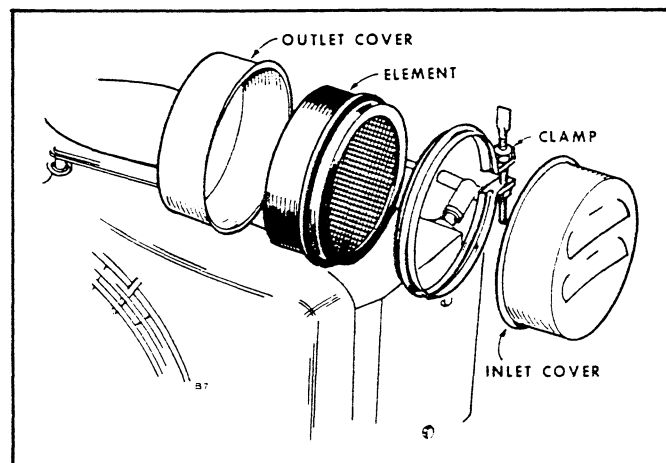


FIGURE 9. AIR CLEANER

be washed in a solution of warm water and mild detergent if additional cleaning seems necessary.

The element will normally require replacement every 500 hours and more often under severe operating conditions.

FUEL SYSTEM

Use lead-free gasoline of a good automotive grade for best results. Only add fuel with the engine stopped, leaving space in the tank for fuel expansion.

GOVERNOR LINKAGE

The linkage must be able to move freely through its entire travel. Every 50 hours of operation clean the plastic joints (do not lubricate) as shown in Figure 10. Also inspect the linkage for binding, excessive slack and wear.

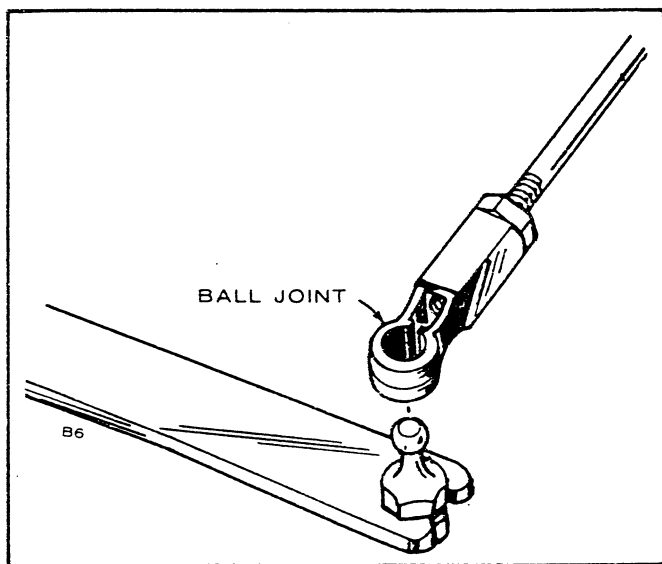


FIGURE 10. GOVERNOR LINKAGE

REDUCTION GEAR DRIVE

Drain the gear box after the first 100 hours of operation and refill with fresh lubricant (SAE 50 motor oil or SAE 90 mineral gear oil). Repeat this procedure every six months thereafter or every 100 hours, whichever is first.

Do not use lubricants commonly known as extreme pressure lubricants, hypoid lubricants, etc.

Maintain the proper oil level between changes. Overfilling will cause foaming, which can lead to an oil leak due to overheating. Remove the filler plug on top of the case and the oil level plug from the face of the gear case. Fill the case until the oil just begins to flow from the oil level plug hole. Gear box holds 1/2 pint U.S. measure. Replace both plugs. See Figure 11.

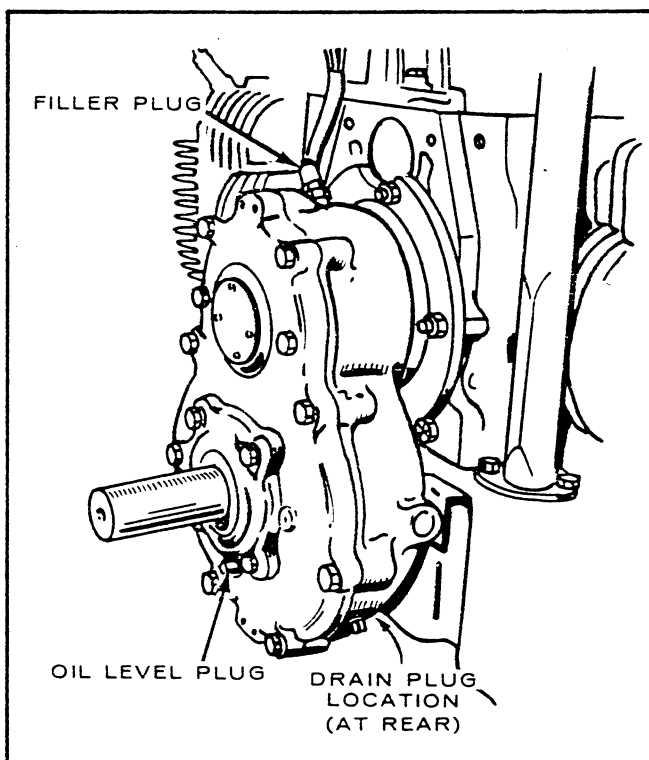


FIGURE 11. REDUCTION GEAR DRIVE

ADJUSTMENTS

GENERAL

Satisfactory engine performance is largely dependent upon correct adjustments. However, adjustments cannot fully compensate for low engine power due to wear, etc. If trouble develops, follow an orderly procedure to determine the cause before making any adjustment. Refer to the Troubleshooting Chart for help in checking causes of troubles which may occur.

CARBURETOR ADJUSTMENT

The carburetor (Figure 12) has a fuel idle adjustment (needle A) and a main fuel adjustment (needle B).

Gasoline: Adjust the carburetor to obtain the correct fuel-to-air mixture for smooth, efficient operation. The carburetor should be adjusted in two steps – first the idle adjustment and then the load adjustment.

IMPORTANT: If the carburetor is completely out of adjustment so the engine will not run, open both needle valves 1 to 1-1/2 turns off their seats to permit starting. Do not force the needle valves against their seats. This will bend the needle.

Before adjusting the carburetor, be sure the ignition system is working properly and the governor is adjusted. Then allow the engine to warm up.

1. With no load, turn the idle adjustment out until the engine speed drops slightly below normal. Then turn the needle in until the engine speed returns to normal.
2. Apply a full load to the engine.
3. Carefully turn the main adjustment in until speed drops slightly below normal. Then turn needle out until speed returns to normal.

Alternate Method: Use When There is No Load Adjustment Possible.

1. Start the engine and allow it to warm up.
2. Pull out on the governor mechanism to slow the unit down to about 400 - 500 rpm.
3. Set the idle adjustment screw for even operation (so the engine is firing on both cylinders and running smoothly).
4. Release the governor mechanism to allow the engine to accelerate. If the engine accelerates evenly and without a lag, the main adjustment is correct. If not, adjust the needle outward about 1/2 turn and again slow down the engine and release the mechanism. Continue until the engine accelerates evenly and without a time lag after releasing the governor.

With the carburetor and governor adjusted, set the throttle stop screw, Figure 12, to allow 1/32 inch clearance to the stop pin with the engine operating at no load. This prevents excessive hunting when a large load is suddenly removed.

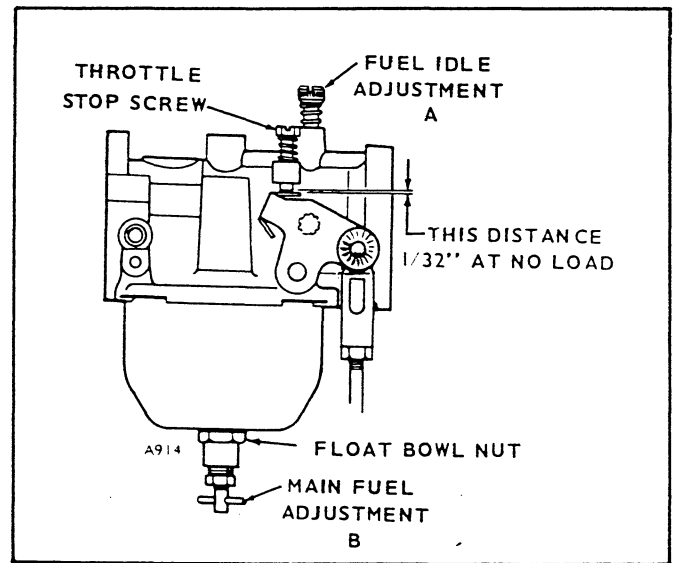


FIGURE 12. CARBURETOR ADJUSTMENTS

Float Level Check: If the carburetor adjustment fails to provide satisfactory operation, check the float level as follows referring to Figures 12 and 13 after removing the carburetor.

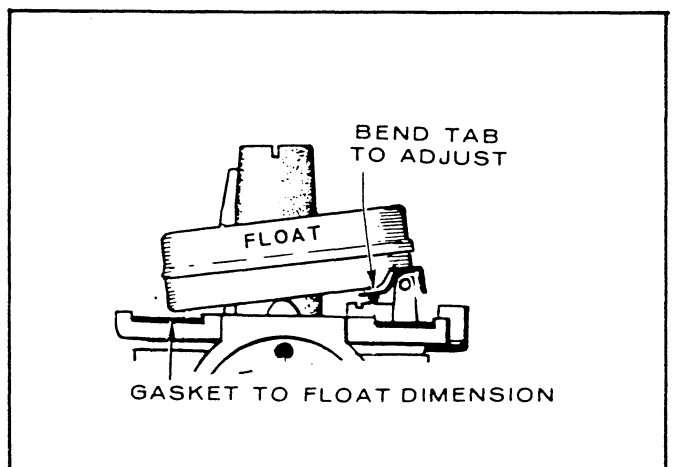


FIGURE 13. FLOAT LEVEL ADJUSTMENT

1. Unscrew the float bowl nut and remove the entire main fuel assembly from the float bowl.
2. Invert the carburetor. Check that the float surface nearest the gasket is $1/8 \pm 1/16$ inch from the gasket. Bend the float tab as required to produce this distance.

NOTE: If the carburetor utilizes an internally spring loaded fuel inlet valve, the float surface should be $1/8 \pm 1/16$ inch from the gasket with the full weight of the float compressing the spring in the needle.

THERMO-MAGNETIC CHOKE (Optional)

This choke uses a strip heating element and a heat sensitive bimetal spring to control the choke plate position. In addition to this, a solenoid is actuated during engine cranking, closing the choke all or part way, depending on ambient temperature. The bimetal is factory set to position the choke to the proper opening under any ambient condition.

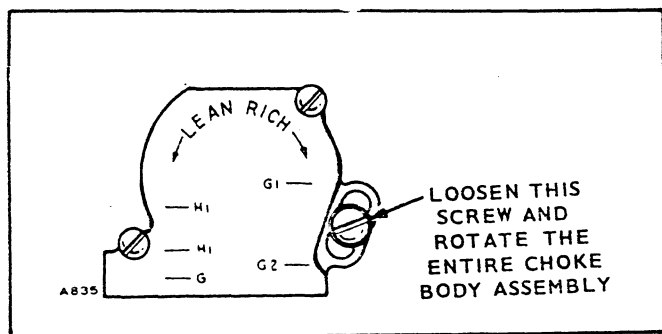


FIGURE 14. THERMO-MAGNETIC CHOKE

If adjustment of the bimetal is needed, it must be made at ambient temperature. Do not attempt adjustments until engine has been shut down for at least one hour. Loosen the screw which secures the choke body assembly. Refer to Figure 14. Rotating the choke body clockwise richens and counterclockwise leans the choking effect. For ambient temperatures above 85°F , the choke should be fully opened. For ambient temperatures below 25°F , the choke should be opened $1/4$ inch with the solenoid not engaged. Tighten the screw that secures the choke body.

BREAKER POINTS

Replace burned or faulty points. If only slightly burned, dress smooth with file or fine stone. Measure gap with thickness gauge. Set point gap at .020 inch.

Ignition breaker points (Figure 15) must be correctly gapped. Crank the engine to fully open breaker points ($1/4$ turn after top center). Loosen and move the stationary contact to correct the gap at full point separation. Secure points and check for correct gap. See Ignition System for timing methods.

Ignition points should break contact just when the timing mark (22°BTC on electric start models and

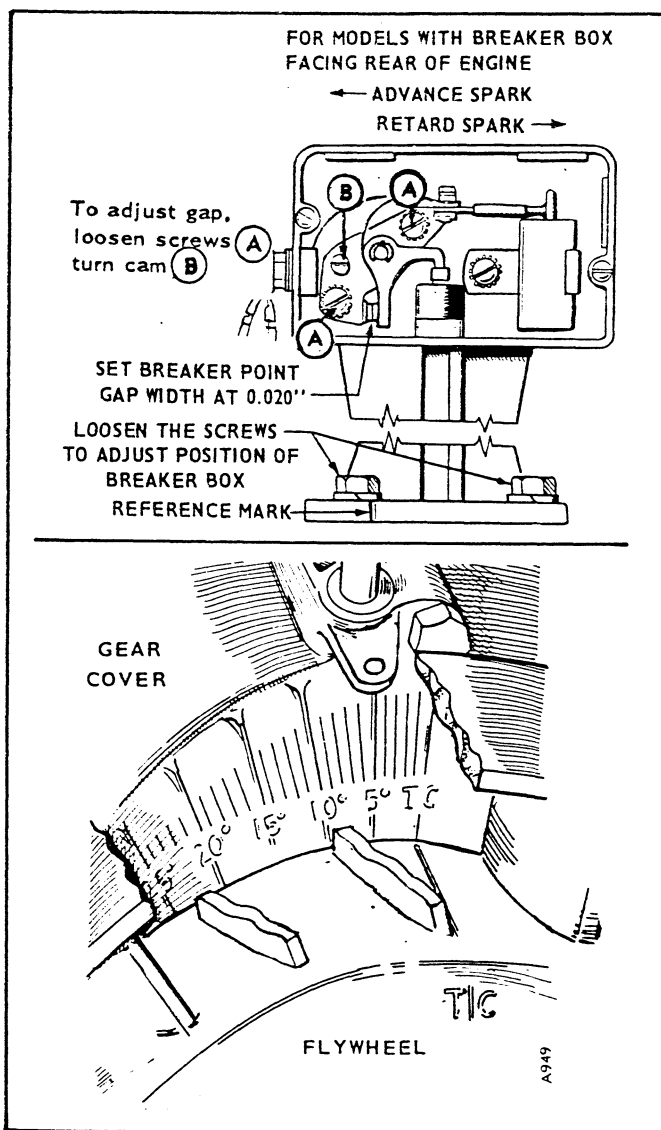


FIGURE 15. IGNITION & TIMING ADJUSTMENTS

3°ATC on manual start models with engine stopped) aligns with the flywheel timing mark. Final timing is corrected by shifting the breaker point box on its mounting base and using a timing light.

GOVERNOR ADJUSTMENT

Where engine speed is governor controlled, the governor is set at the factory to allow a nominal engine speed of 2400rpm at no load operation (unless another speed is specified when the engine is ordered). Proper governor adjustment is one of the most important factors in maintaining the power and speed desired from the engine.

Before making governor adjustment, run the engine about 15 minutes to reach normal operating temperature.

It is difficult to determine if, after long usage, the governor spring has become fatigued. If, after properly making all other adjustments, the regulation is still erratic, install a new spring (Figure 16).

A tachometer for checking engine speed is required for accurate governor adjustment.

Check the governor arm, linkage, throttle shaft and lever for binding or excessive wear at connecting points. A binding condition at any point will cause the governor to act slowly and regulation will be poor. Excessive looseness will cause a hunting condition and regulation will be erratic. Work the arm back and forth several times by hand while the engine is idle. If either of these conditions exist, determine the cause and adjust or replace parts as needed.

Procedure:

1. Adjust the carburetor main jet for the best fuel mixture at full load operation.
2. Adjust the carburetor idle needle with no load connected.
3. Adjust the length of the governor linkage.
4. Check the governor linkage and throttle shaft for binding or excessive looseness.
5. Adjust the governor spring tension for nominal engine speed at no load operation.
6. Check the rpm drop between no load and full load

operation and adjust the governor sensitivity as needed.

7. Recheck the speed adjustment.

8. Set the carburetor throttle stop screw.

Linkage: The engine starts at wide open throttle. The length of the linkage connecting the governor arm to the throttle arm is adjusted by rotating the ball joint housing. Adjust the length so that with the engine stopped and tension on the governor spring, the stop on the carburetor throttle lever is 1/32 inch from the carburetor stop boss. This setting allows immediate control by the governor after starting and synchronizes travel of the governor arm and the throttle shaft.

Speed Adjustment: The speed at which the engine operates is determined by the tension applied to the governor spring. Increasing spring tension increases engine speed. Decreasing spring tension decreases engine speed. The no load speed of the engine should be slightly higher than the speed requirements of the connected load. For example: If the connected load is to turn at 3510 rpm, set the no load speed of the engine at about 3600 rpm. Check speed with a tachometer.

If a speed adjustment is needed, turn the speed adjusting nut in to increase the speed or out to decrease

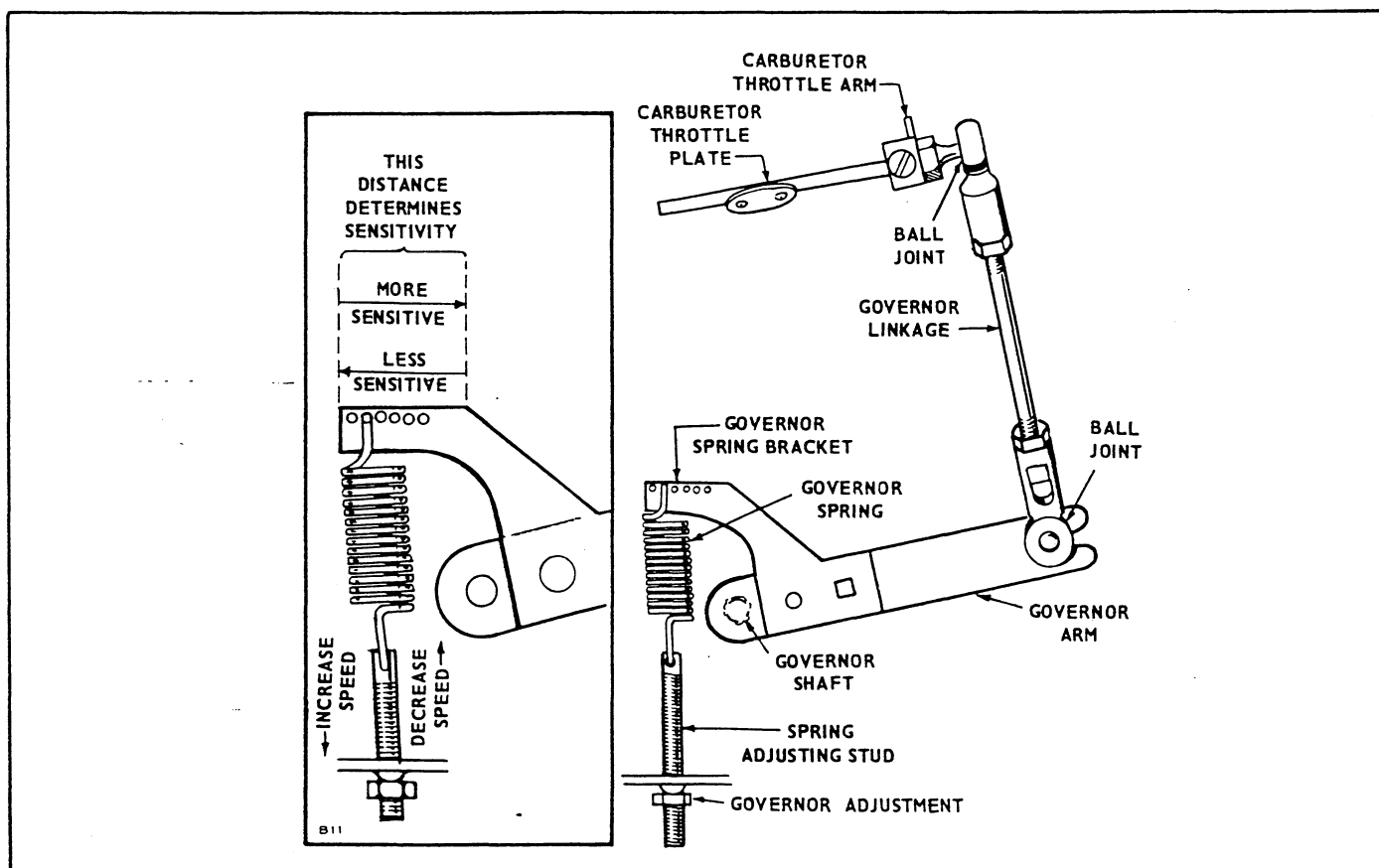


FIGURE 16. GOVERNOR ADJUSTMENTS

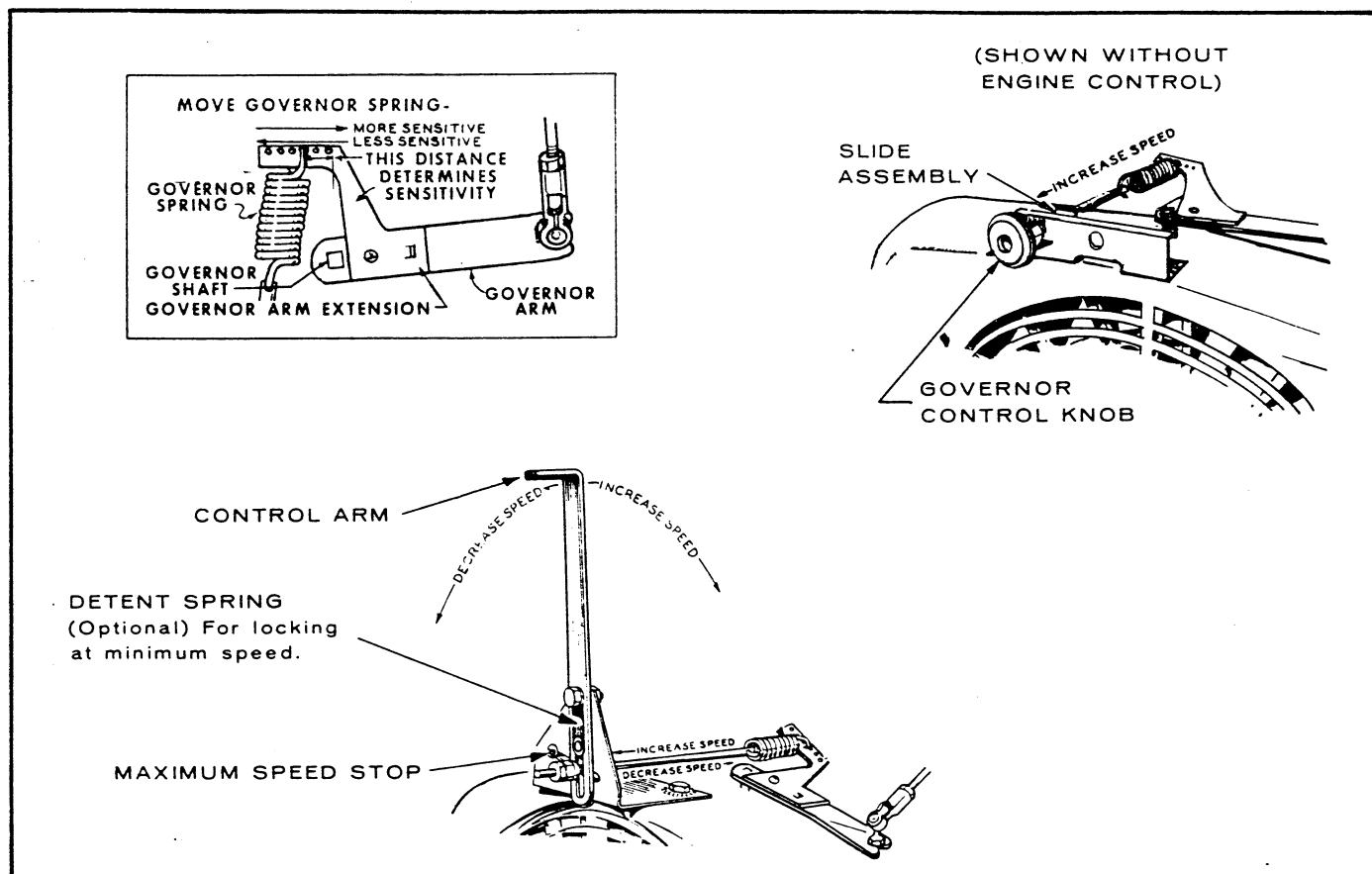


FIGURE 17. VARIABLE SPEED GOVERNORS

the speed (Figure 16).

SENSITIVITY ADJUSTMENT

The engine speed drop from no load to full load should be not less than 100rpm. Check the engine speed with no load connected and again after connecting full load. Do not exceed 4000rpm at no load.

The sensitivity of the governor depends upon the position of the arm end of the governor spring. A series of holes in the governor arm provides for adjustment. To increase sensitivity, move the spring toward the governor shaft. To decrease sensitivity, move the spring toward the linkage end of the governor arm.

If the setting is too sensitive, a hunting condition (alternate increase and decrease in engine speed) will result. If the setting is not sensitive enough, the speed variation between no load and full load conditions will be too great. Therefore, the correct sensitivity will result in the most stable speed regulation without causing a surge condition.

Always recheck the speed adjustment after a sensitivity adjustment. Increasing sensitivity will cause a slight decrease in speed and will require a slight increase in the governor spring tension.

Variable Speed Governor Adjustments: These engines

are adapted for use where a wide range of speed settings is desired. The design of the variable speed governors gives an automatic increase in sensitivity when the speed is increased and the result is good stability at all speeds.

To adjust the variable speed governors, refer to Figure 17 and the following:

1. Run the engine and make necessary carburetor adjustments.
2. Adjust the throttle stop screw on the carburetor to allow a recommended minimum idling speed of 900rpm. A lower minimum does not assure smooth operation under load.
3. Adjust the tension of the governor spring for minimum speed. For the control with the control arm, shift the lever to minimum speed with no load and adjust the spring tension for approximately 1500 rpm.

For the control with the control knob and slide (NH engines with mounted engine controls), pull back the knob and slide and set at the first notch (low speed). Adjust speed to approximately 1500rpm (or the desired low speed) at no load by turning the knob as required.

4. Adjust the sensitivity while operating at minimum speed to attain the smoothest no load to full load operation as follows:

To decrease sensitivity (allow more speed drop from no load to full load operation) move the governor spring outward into a different groove or hole in the extension arm.

To increase sensitivity (closer regulation by the governor which permits less speed drop from no load to full load operation) move the governor spring inward into a different groove or hole in the extension arm.

5. Apply a full load and shift the variable control to maximum speed – moving the control arm to the right or shifting the control knob and slide to the second notch. For the governor control with the control arm, set the screw in the bracket slot to stop lever travel at the desired maximum full load speed position. For the control with the control knob and slide, increase or decrease speed by turning the knob as required.

Approximately 3000rpm is the recommended maximum full load speed for continuous operation. The speed must agree with the load requirements.

ADJUSTING THE STARTER TO THE RING GEAR

When assembling the starter to the engine oil base, do not draw the mounting bolts up tight. The gears should have from .004" to .007" backlash. Tap the starter bracket in or out from the oil base to adjust the backlash in the gears. Be sure to tighten the bracket bolts securely.

ADJUSTING ROCKFORD CLUTCH (Figure 18)

With the engine stopped, the clutch released (dis-

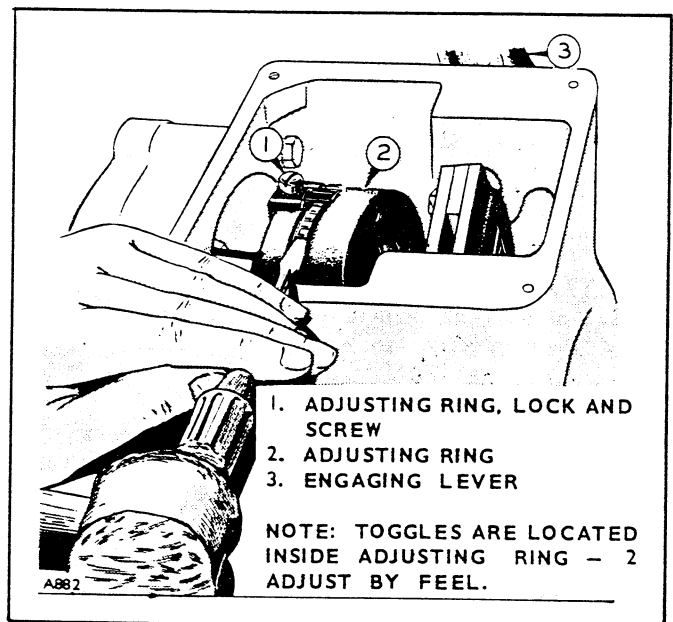


FIGURE 18. ROCKFORD CLUTCH ADJUSTMENTS

engaged lever position) and the top plate removed from the clutch housing, turn the adjusting ring (2) inward (clockwise facing power takeoff shaft) until the toggles cannot be locked over center. The locking screw (1) may remain tightened.

Loosen the adjusting ring a notch or two at a time until the toggles can be locked over with a very firm pull on the engaging lever (3).

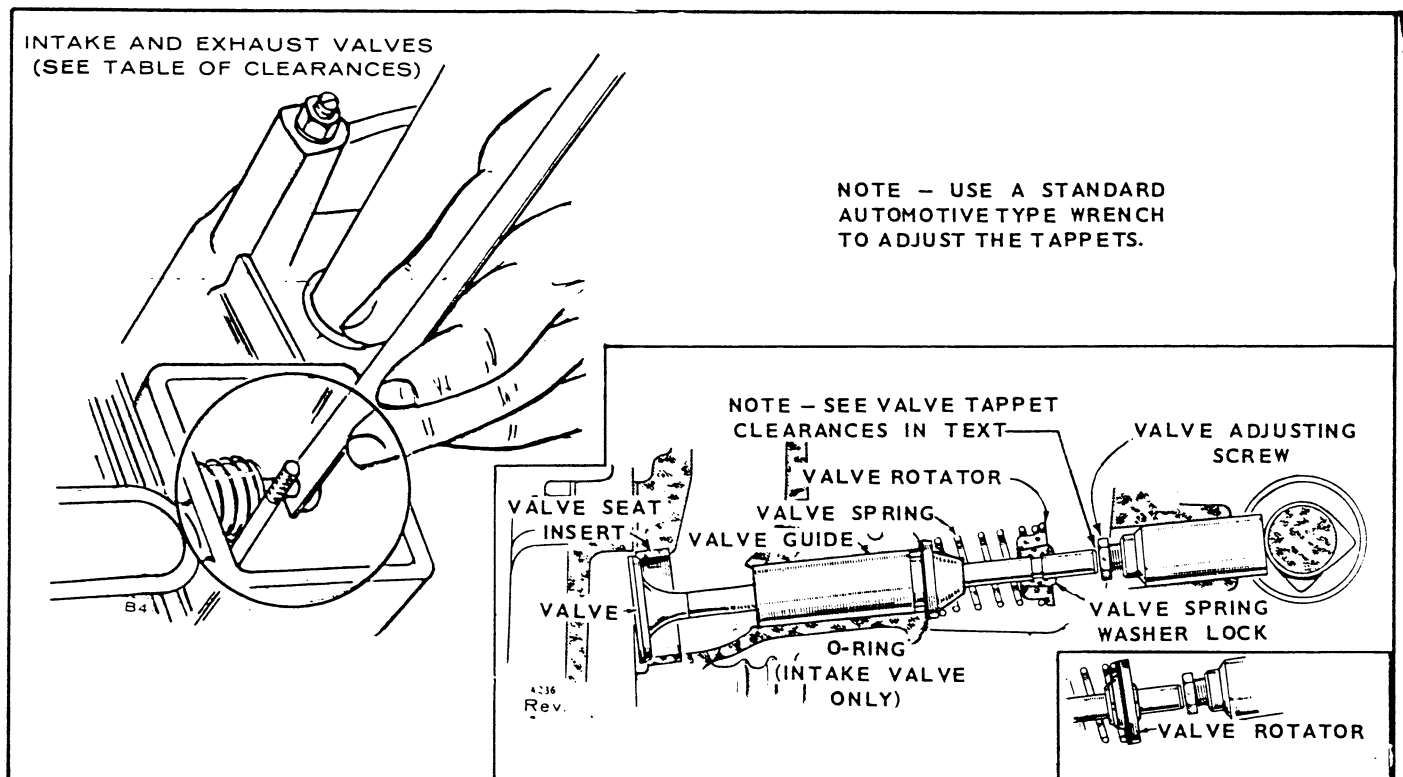


FIGURE 19. TAPPET ADJUSTMENT

Start the engine and work the engaging lever back and forth several times, allowing the clutch to pick up load but not to lock over center. This is especially important with a new clutch plate as it removes the high spots and particles of fibers.

Stop the engine and tighten the adjusting ring two or three notches for final adjustment.

IMPORTANT: *Be sure the toggles lock over center at final adjustment, with a very firm pull on the engaging lever required to engage the clutch.*

TAPPET ADJUSTMENT

The engine is equipped with adjustable tappets. To make a valve adjustment, remove the valve covers. Crank the engine over slowly by hand until the left hand intake valve, when facing the flywheel, opens and closes. Continue about 1/4 turn until the mark on the flywheel and the TC mark on the gear cover are in line. This should place the left hand piston at the top of its compression stroke, the position it must be in to get proper valve adjustment for the left hand cylinder. Clearances are shown in Dimensions and Clearances. For each valve, the gauge should just pass between the valve stem and valve tappet (Figure 19).

To correct the valve clearance, turn the adjusting screw as needed to obtain the right clearance. The screw is self-locking.

To adjust the valves on the right hand cylinder, crank the engine over one complete revolution and again line up the mark on the flywheel and the TC mark on the gear cover. Then follow the adjustment given for the valves of the left hand cylinder.

OIL PRESSURE RELIEF VALVE ADJUSTMENT

Engine oil pressure is adjusted by means of the slotted stud and locknut located near the breather tube. See Figure 20. Oil pressure readings, when the engine is thoroughly warmed up, should be between 30 and 35 lbs. To increase oil pressure, loosen the locknut and turn the stud inward. To decrease oil pressure, loosen the locknut and turn the stud outward. Be sure to tighten the locknut securely after making an adjustment. The spring and plunger can be removed and cleaned.

Low oil pressure may indicate worn main or connecting rod bearings, improper clearance at these points, a weak or broken bypass spring, an improperly adjusted

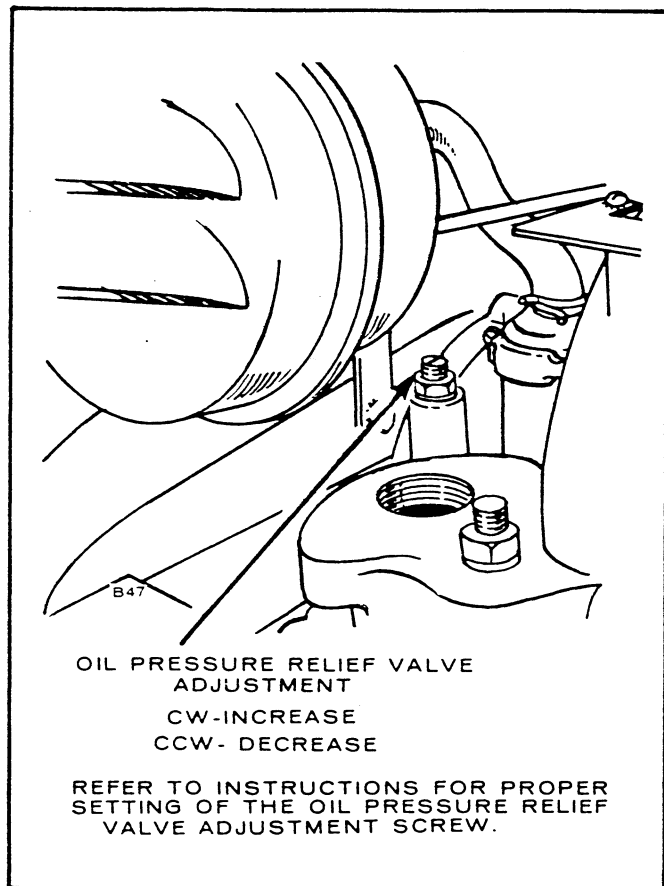


FIGURE 20. OIL PRESSURE RELIEF VALVE ADJUSTMENT

bypass or a defective gauge. Check the oil pressure gauge before making any other test; it may be defective.

EXTERNAL, 35 AMPERE ALTERNATOR

This optional, 12 volt alternator is used only on the electric start NH engines.

It includes its own mounted and sealed transistorized voltage regulator. Because it's belt driven off the pulley on the engine flywheel, periodically check the belt tension. Press down on the belt halfway between the alternator and flywheel pulleys. There should be approximately a 1/2 inch deflection.

CAUTION

Always be sure battery negative terminal is grounded.

FUEL SYSTEM

CARBURETOR

Keep the carburetor clean. Some types of gasoline have a tendency toward formation of gum deposits inside the carburetor. This gum formation can usually be removed by soaking in alcohol or acetone. A fine wire may be used to clean the jets.

Cleaning and Repair: To clean the carburetor, soak all components thoroughly in a good carburetor cleaner, following the cleaner manufacturer's instructions. Be sure all carbon is cleaned from the carburetor bore, especially in the area of the throttle valve. Blow out the passages with compressed air. If possible, avoid using wire to clean out the passages.

Check the adjusting needles and nozzle for damage. If the float is loaded with fuel or damaged, replace it. The float should fit freely on its pin without binding. Invert the carburetor body and measure the float level, Figure 13 in Adjustment Section.

If necessary, bend the small lip on which the intake valve rides to adjust float level.

Check the choke and throttle shafts for excessive side play and replace if necessary.

REMOVAL AND DISASSEMBLY

1. Remove the fuel line, air cleaner hose, governor linkage and choke wires.
2. Remove the two carburetor mounting nuts and remove the carburetor.
3. If the engine is equipped with an automatic choke, remove the two screws that fasten the choke to the carburetor and remove the assembly.
4. Remove the main jet assembly and bowl.
5. Remove the float pin and float. See Figure 21.
6. Lift out the fuel inlet valve and unscrew the valve seat.
7. Remove the no load adjusting needle.
8. Remove the throttle plate screws and the plate and pull out the throttle shaft.
9. Remove the choke plate screws and plate and pull out the choke shaft.

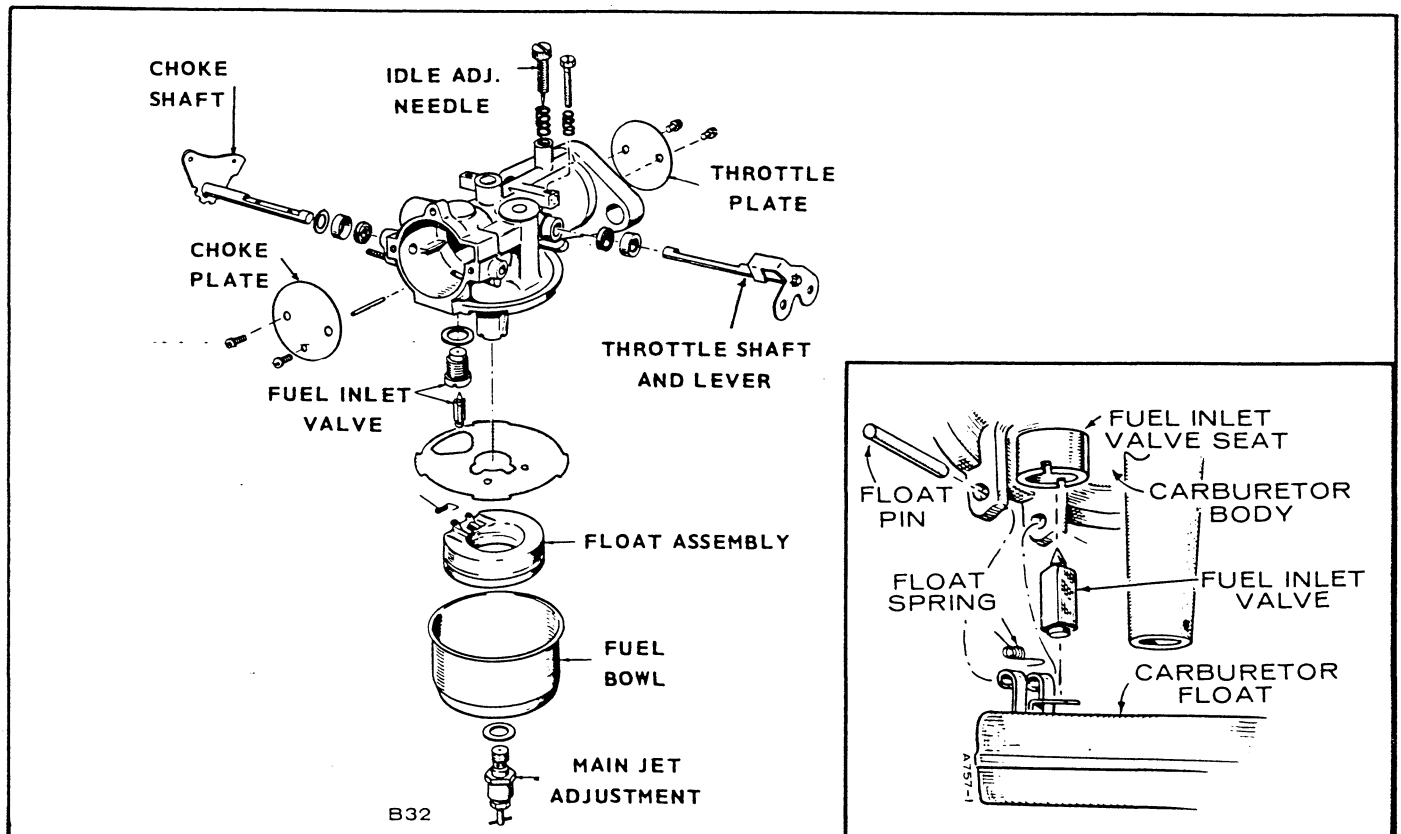


FIGURE 21. CARBURETOR ASSEMBLY

ASSEMBLY AND INSTALLATION

1. Install the throttle shaft and plate, using new screws and lock washers. Install with bevel mated to the carburetor body. On plates marked with the letter C, install with the mark on the side toward the idle port when viewed from the flange end of the carburetor. To center the plate, back off the top screw, close the throttle lever and seat the plate by tapping it with a small screwdriver. Then tighten the two screws.
2. Install the choke shaft and plate. Center the plate in the same manner as the throttle plate (step 1). Use new screws and lock washers.
3. Install the fuel inlet valve seat and valve.
4. Install the float and float pin. Center the pin so the float bowl does not ride against it.
5. Check the float level with the carburetor casting inverted. See Figure 13 in Adjustment Section.
6. Install the bowl ring gasket, bowl and bowl nut. Make sure that the bowl is centered in the gasket and tighten the main jet assembly securely. Turn in until it seats and back out 1 to 1-1/2 turns.
7. Install the idle adjusting screw finger tight. Then back out 1 to 1-1/2 turns.
8. Install the choke and adjust. See Figure 14 in Adjustment Section.
9. Install the carburetor on the engine and connect the gasoline inlet and governor mechanism.
10. Install the air cleaner hose.

THERMAL MAGNETIC CHOKE (Optional)

If the choke will not close, check for binding, incorrect

adjustment, or incorrect assembly of the bimetal and heater assembly. If the choke will not open after the engine starts, check for heating. The choke bimetal should be warm to the touch within a minute or two after starting.

To disassemble the choke, refer to Figure 22.

If the heater assembly will not heat properly, check for broken heater wire, high resistance connections or broken lead wires to the bimetal and heater assembly. With the element at room temperature, check the heater resistance with an ohmmeter. The resistance should be about 37.8 to 46.2 ohms for a 12 volt system. If the heater is defective, replace. There must be slack in the lead wires between the choke body and the bimetal and heater assembly. When the start button is engaged, the solenoid should cause the spring loaded lever to contact the solenoid core. If this does not occur, check for broken lead wires or a defective solenoid core.

The solenoid coil should have a resistance of 2.09 to 2.31 ohms in a 12 volt system.

Assembly: Refer to Figure 22. When assembling the thermomagnetic choke, connect the bimetal and heater assembly as follows:

1. Lead tagged G to ground terminal in coil solenoid.
2. Lead tagged H to either of the H1 terminals on the solenoid core.

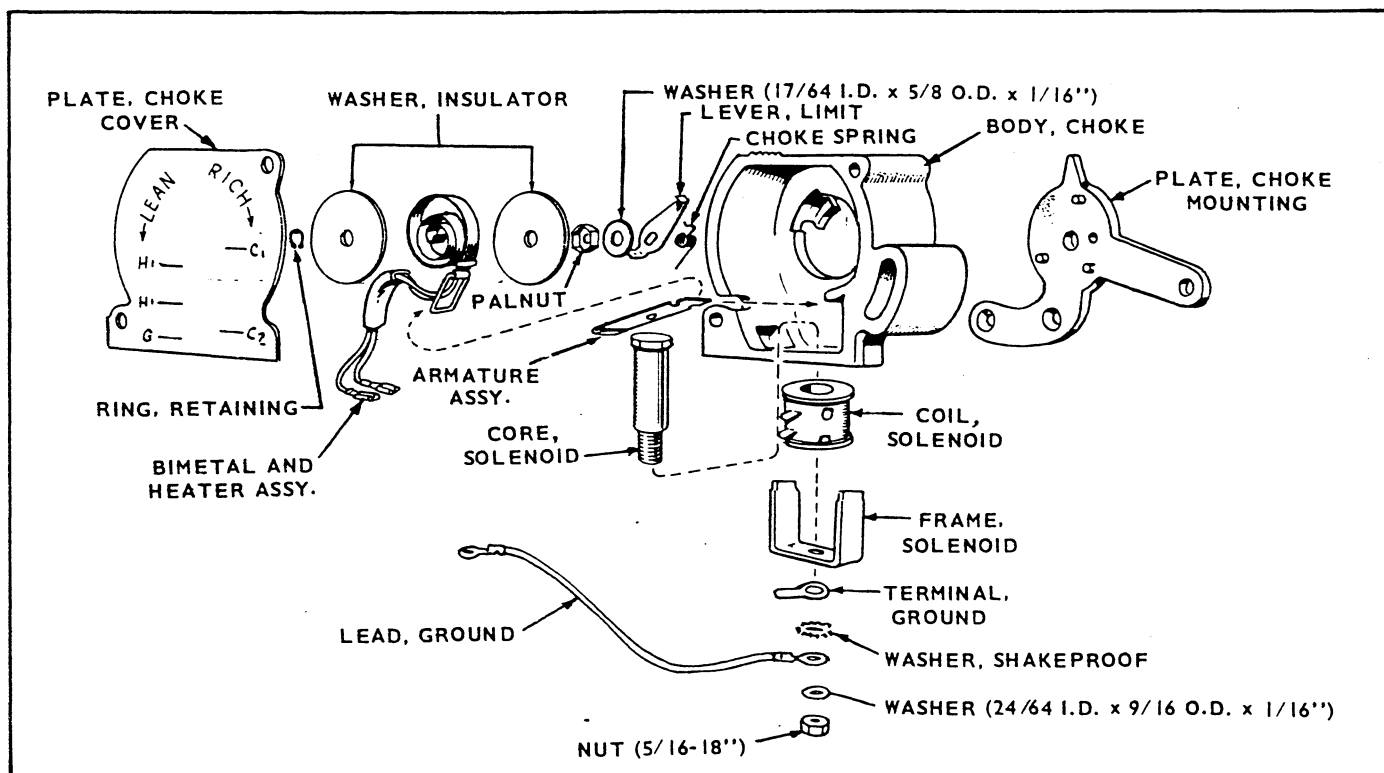


FIGURE 22. CHOKE ASSEMBLY

FUEL PUMP

A diaphragm type fuel pump is used. If fuel does not reach the carburetor, check the fuel pump. To do this, disconnect the fuel line at the carburetor and, while cranking the engine slowly by hand, observe whether fuel comes through the line. Be sure there is fuel in the tank. If the line is open and no fuel comes through, the pump is defective. Failure of the pump is usually due to a leaking diaphragm valve or valve gasket, a weak or broken spring, or wear in the drive linkage. Oil diluted with gasoline may indicate a faulty diaphragm. If the operator chooses to repair the pump rather than install a new one, the use of a complete repair kit is recommended.

NOTE: Always return the hand priming lever all the way inward so that the priming lever does not prevent the normal operation of the pump.

FUEL PUMP RECONDITIONING (Figure 23)

1. Remove fuel lines and mounting screws holding pump to engine.
2. Make an indicating mark with a file across a point at the union of the fuel pump bolt and cover. This mark will assure proper reassembly. Remove

assembly screws and remove upper pump body.

3. Turn pump body over and remove valve plate screw and washer. Remove valve retainer, valves, valve springs and valve gasket, *noting their position*. Discard valve springs, valves and valve retainer gasket.
4. Clean pump body thoroughly with solvent and a fine wire brush.
5. Holding the pump cover with the diaphragm surface up, place the new valve gasket into the cavity. Assemble the valve spring and valves in the cavity. Reassemble the valve retainer. Lock in position by inserting and tightening fuel pump valve retainer screw.
6. Place pump body assembly in a clean place and rebuild the lower diaphragm section.
7. Holding mounting bracket, press down on the diaphragm to compress spring under it, then turn bracket 90° to unhook diaphragm so it can be removed.
8. Clean mounting bracket with a solvent and a fine wire brush.
9. Replace the diaphragm fuel pump rod spring, diaphragm gasket, stand new spring in casting, position diaphragm, compress spring and turn

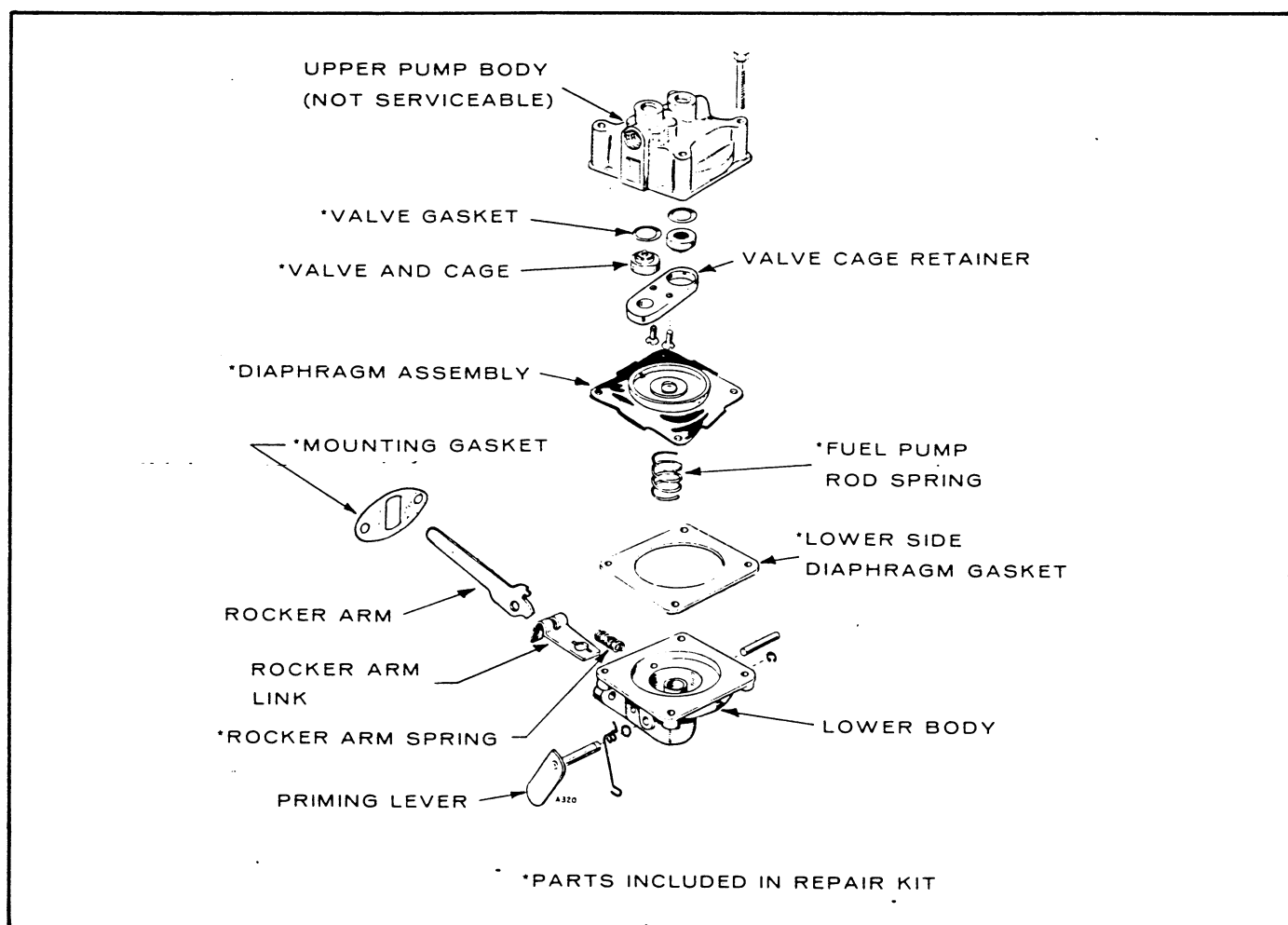


FIGURE 23. FUEL PUMP

90° to reconnect diaphragm.

10. Hold bracket, then place the pump cover on it (make sure that indicating marks are in line) and insert the four screws. DO NOT TIGHTEN. With the hand on the mounting bracket only, push the pump lever to the limit of its travel and hold

in this position while tightening the four screws. This is important to prevent stretching the diaphragm.

11. Mount the fuel pump on engine, using new mounting gaskets. Connect the fuel lines.

IGNITION AND BATTERY CHARGING SYSTEMS

ELECTRIC START

The electric start engines are equipped with a 12 volt solenoid shift starter mounted to the oil base. A 20 ampere flywheel alternator and a solid state temperature compensated regulator is provided for battery charging. These engines have 22° BTC fixed timing. The correct timing is stamped on the cylinder block near the breaker box

Breaker Points

To obtain maximum efficiency from the engine, change the breaker points every 200 hours of operation. Referring to Figures 24 and 25, proceed as follows:

1. Remove the two screws and the cover on the breaker box.
2. Remove the two spark plugs so engine can be easily rotated by hand.
3. Remove the breaker point mounting screws and replace points with a new set. Do not completely tighten breaker point mounting screws at this point.
4. Rotate the engine clockwise by hand until the mark on flywheel and TC mark on gear cover align

(Figure 25).

5. Turn the points adjusting cam screw (B) until the point gap is .020" and tighten mounting screws (A).
6. Turn flywheel to left past timing marks. Now turn to right. Points should separate when flywheel TC mark aligns with correct degree mark. If not, it's necessary to set the ignition timing.

Ignition Timing – Engine Running

Spark advance is set at 22° BTC (before top center). Always check timing after replacing ignition points or if noticing poor engine performance. Proceed as follows:

1. To accurately check the ignition timing, use a timing light when engine is running. Connect the timing light according to its manufacturer's instructions. Either spark plug can be used as they fire simultaneously.
2. Place a white chalk or paint mark on the 22° timing mark. Engines having Vacu-Flo cooling gain access to timing marks by removing the plug just above the top of the oil filter.
3. Start the engine and check the timing. The TC mark on the flywheel should line up with the 22° mark on the cover.
4. If timing needs adjustment, loosen the mounting

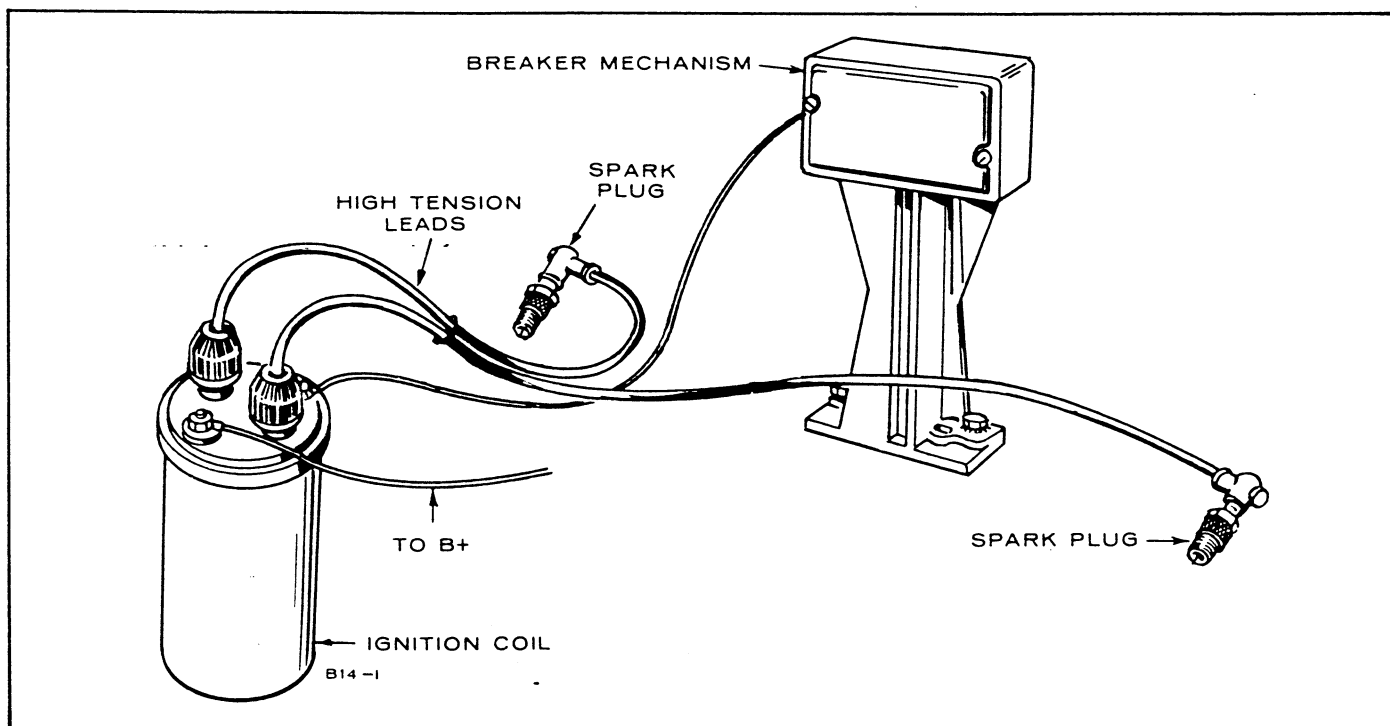


FIGURE 24. IGNITION SYSTEM

screws on breaker box and move left to advance or right to retard the timing.

5. Start engine to be sure TC mark on flywheel lines up with 22° mark on cover.
6. Tighten all screws, replace timing plug, breaker box cover (Figure 25) and any other hardware removed. --

Ignition Timing – Engine Not Running

1. Connect a continuity test lamp set across the ignition breaker points. Touch one test prod to the breaker box terminal to which the coil lead is connected and touch the other test prod to a good ground on the engine.
2. Turn crankshaft against rotation (counterclockwise) until the points close. Then slowly turn the crankshaft with rotation (clockwise).
3. The lamp should go out just as the points break (22°BTC).

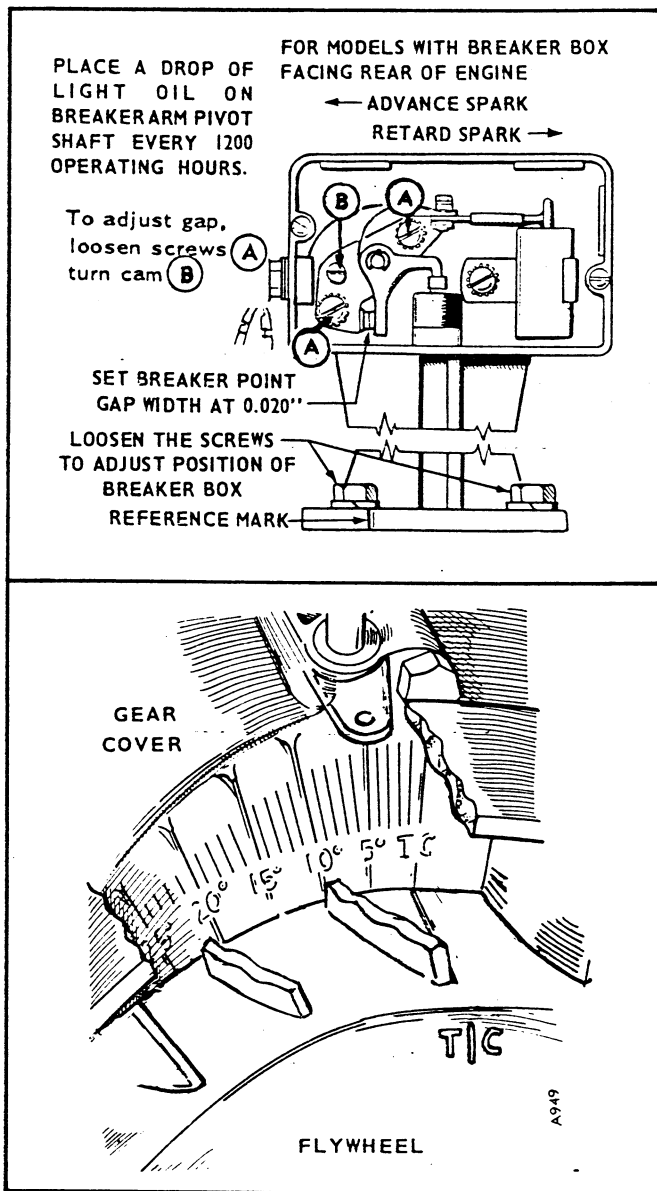


FIGURE 25. IGNITION & TIMING ADJUSTMENTS

MANUAL START

A rope starter sheave is provided on the face of the blower wheel for starting the engine. The spark is retarded to 3°ATC during the start cycle to prevent kick. An optional mechanical rewind starter is also available.

Magneto (Figure 26)

The magneto stator assembly is mounted on the gear cover and the flywheel must be removed to expose the magneto. The stator coil includes both the primary and the secondary windings. There is no separate automotive type coil used. Connect the smaller (ground) coil lead under one of the stator mounting screws. Connect the other lead to the breaker box insulated terminal which also connects to the breaker points. Be sure the lead to the point box is held in place to prevent rubbing on the flywheel.

Spark Advance Mechanism (Figure 27)

The spark advance mechanism is located on the rear of the camshaft and is standard on magneto models. It is operated by centrifugal force. As the engine speeds up, the weights rotate the cam and advance the spark. The cam returns to the retarded position as the engine speed is decreased. If the mechanism should become dirty or gummy, it would remain closed (retarded), causing the engine to lose power. If the mechanism remains open (advanced), the engine would possibly kick back on cranking. The cam advance must be snap acting. Should the engine fail to pick up speed or tend to alternately increase and decrease speed, the mechanism may require cleaning.

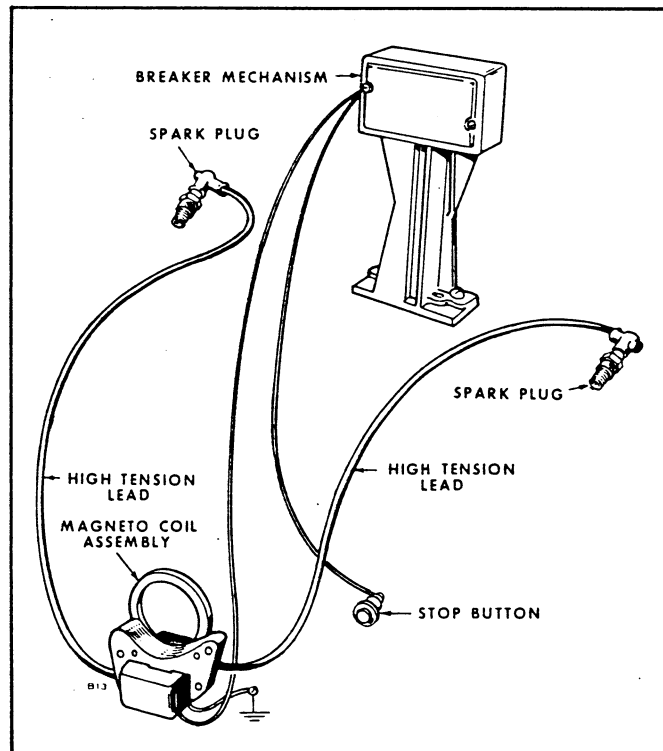


FIGURE 26. IGNITION SYSTEM

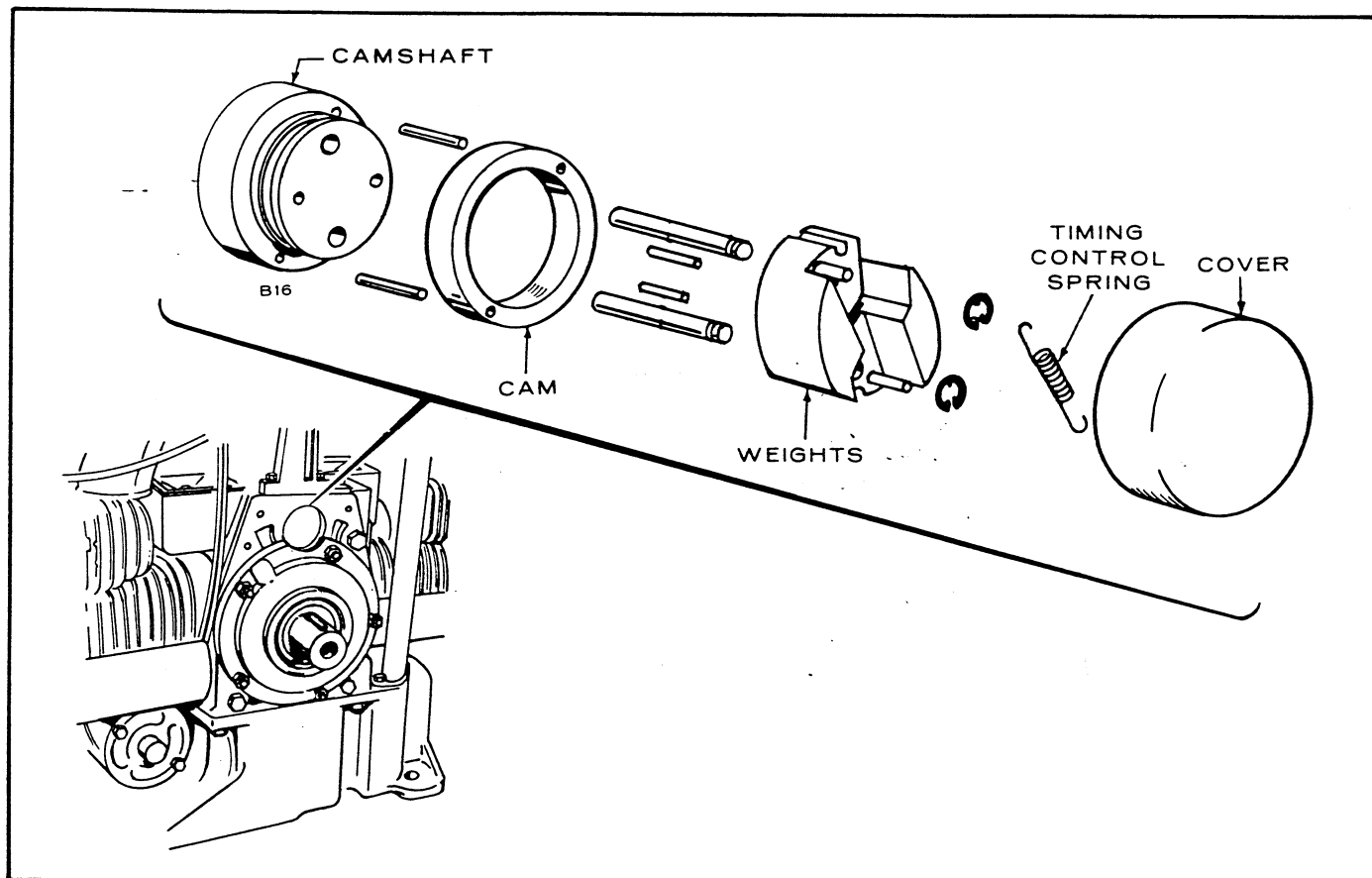


FIGURE 27. SPARK ADVANCE MECHANISM

The spark advance mechanism can be reached for cleaning by either removing the cup shaped cover in the crankcase rear camshaft opening to expose the mechanism or by removing the camshaft from the engine. Do not indent the cup shaped cover as it will interfere with the weight mechanism.

Checking Advance Mechanism

1. The timing marks will be visible through the flywheel.
2. Connect timing light to spark plug.
3. Start engine and run at 1500 rpm or over.
4. View the timing marks, using a timing light. The "TC" flywheel mark should align with the mark on gear cover.
5. While watching the timing marks with the timing light, slow the engine to below 800 rpm. If the "TC" mark on the flywheel disappears and then reappears when the engine is brought back to speed, the mechanism is operating properly.
6. If the ignition advance mechanism DOES NOT REACT as described in step #5, remove, clean and/or replace as necessary.
7. Replace the cover.

IGNITION TIMING (Manual Start)

The timing for the NH engine is 3°ATC (engine stopped) and 22°BTC (engine running). These numbers are stamped on the crankcase near the breaker box

for reference. Timing marks are located on the gear cover and the TC mark is on the flywheel.

Be sure to set the breaker point gap to .020". Follow procedures given under ELECTRIC START ENGINES. For correct timing, use a timing light at engine speeds over 1500 rpm preferably at normal operating speed. The TC mark on the flywheel must be aligned with the 22° mark.

If a timing light is not available, timing can be set with the engine stopped. To do this, estimate the location of the 3°ATC mark on the gear cover since it is not marked. The TC mark on the flywheel must be aligned with the estimated 3°ATC position. A continuity test lamp can be used for this.

Tighten the breaker box mounting screws securely after making adjustments.

ONAN BATTERY CHARGING, FLYWHEEL ALTERNATOR (Optional)

The flywheel alternator is a permanent magnet alternator and uses a solid-state voltage regulator-rectifier for controlling output (Figure 28).

A 30 ampere fuse is included in the battery charging system to protect the alternator in case the battery

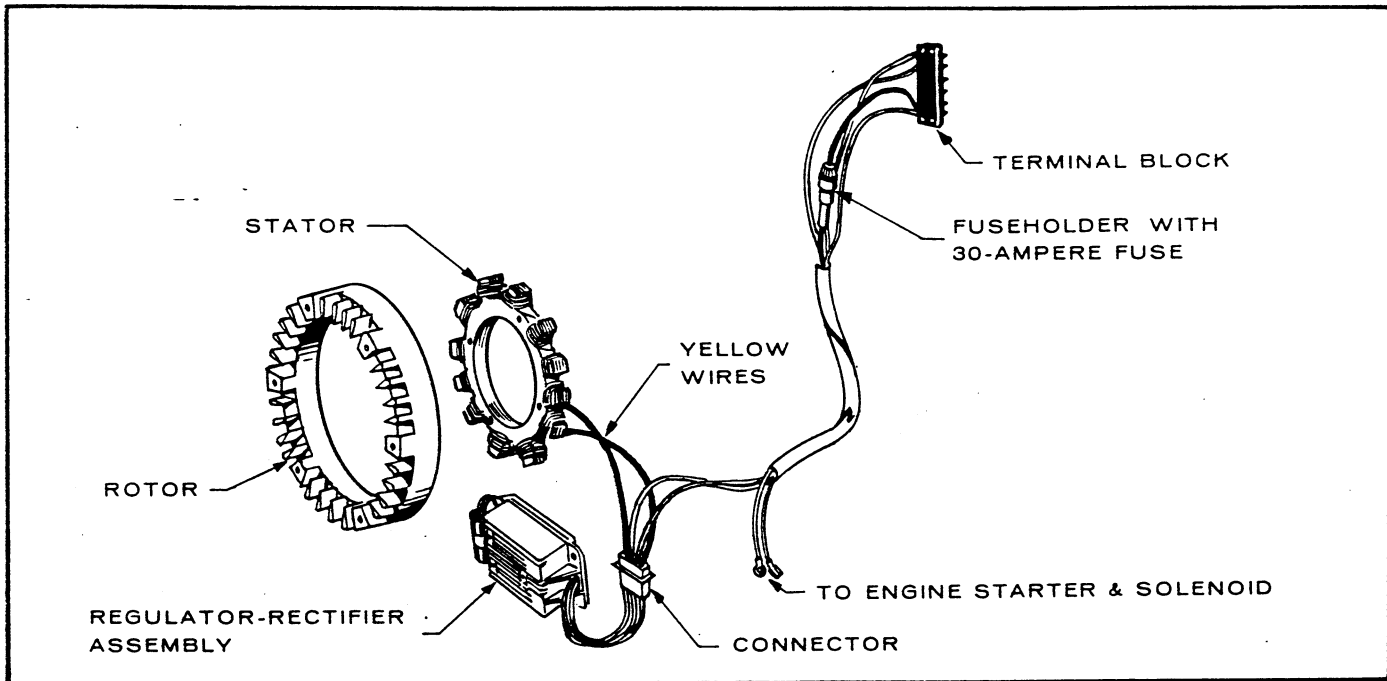


FIGURE 28. OPTIONAL FLYWHEEL, BATTERY CHARGING ALTERNATOR

cables are accidentally reversed. Replace the fuse with Onan fuse 321-162, Buss AGC30 or equivalent.

Weak ignition spark or a discharged battery indicate trouble in the charging system. But before testing the engine's charging system, always check the battery for serviceability.

Keep these points in mind when testing or servicing the flywheel alternator:

1. Be sure the output control plug (connector) is inserted properly. The plug must bottom in receptacle—eliminates any resistance due to a poor connection. Keep clean and tight.
2. Be sure regulator-rectifier output control has a good ground connection. Mating surface for mounting must be clean and fasteners tightened properly.
3. Never reverse the battery leads.

Regulator-Rectifier Tests

NOTE: The following tests for the regulator-rectifier require a fully-charged battery.

1. Connect a voltmeter across the battery. Start the engine and operate at 1800 to 3600 rpm.
2. Voltmeter should read 13.4 to 14.05 volts. If it does, no further testing of the charging system is necessary. If not, install a new regulator-rectifier and retest. Be sure it has a good ground connection and the connector is properly seated.

Stator Tests

For testing, use a Simpson 260 VOM or equivalent. Be sure test meter and battery, if battery powered, are in good condition. Check with engine NOT running.

1. Set voltage selector switch to DC+ and zero meter on RX1 scale.

NOTE: Zero the meter before each reading and each time scales are changed.

2. Unplug the connector and connect the meter leads to the two terminals of the female plug with the yellow wires. Meter should read less than 0.8 ohms if stator has continuity. If meter shows no reading, winding is open and stator should be replaced.
3. Touch red meter lead to yellow wire plug terminal and other meter lead to metal core of stator. If meter doesn't read infinity, the stator winding is grounded. Replace the stator.

Flywheel Magnet Group or Rotor

To test the magnet group or rotor, lay a piece of ferrous (iron) material up against the magnets to be sure they are charged. If not, replace the rotor.

If the rotor is removed and replaced, use approximately 5 ft-lb torque on the mounting bolts.

EXTERNAL, BATTERY CHARGING ALTERNATOR

This information is presented for field use only. If a major repair should become necessary, contact your local authorized dealer.

Brush Assembly Removal: Remove the three screws which fasten the voltage regulator to the alternator. See Figure 29. Disconnect the regulator leads and remove the regulator.

Remove the two screws on the phenolic cover and lift out the cover and gasket.

Pull the brush assembly straight up and lift out. Reverse the procedure for assembly.

Brush Assembly Tests: Connect an ohmmeter or test lamp (12 or 120 volts) to the field terminal and to the bracket. The test lamp shouldn't light or resistance reading should be high (infinite). If not, there is a short and the assembly must be replaced.

Now move the one ohmmeter lead from the bracket to the insulated brush. Use an alligator clip directly on the brush. Be careful not to chip it. Resistance reading should be zero (continuity).

Connect the ohmmeter leads to the grounded brush and the bracket. Resistance should be zero.

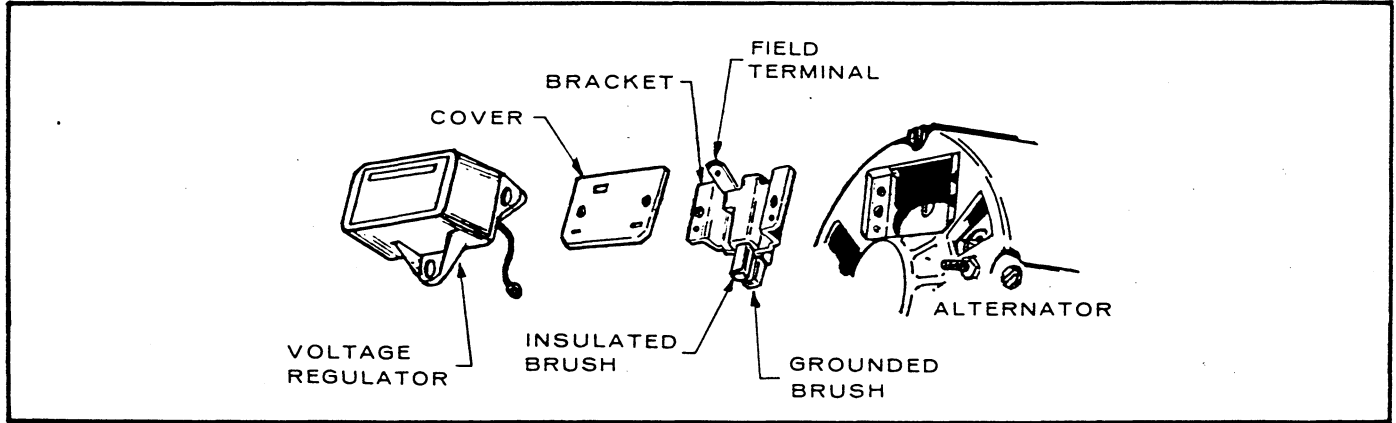


FIGURE 29. OPTIONAL BATTERY CHARGING, EXTERNAL ALTERNATOR

STARTING SYSTEM

ELECTRIC STARTER REPAIR (Figure 30)

CAUTION Do not use steam or high pressure water to clean the starter.

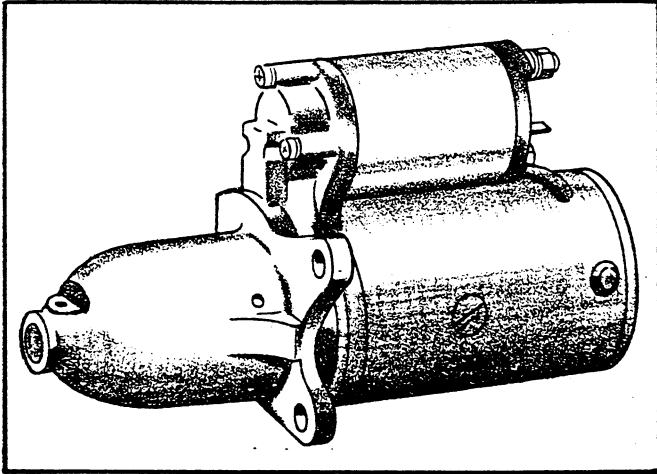


FIGURE 30. STARTER ASSEMBLY

DISASSEMBLY (Figure 31)

1. Loosen the M terminal nut on the magnetic switch and remove the connector. Then unscrew attaching screws and remove the magnetic switch.

NOTE: The packings for the magnetic switch are mounted so that the steel packing is located in the front bracket side.

2. After removing the thru bolts, the starting motor can be divided into three parts – the front bracket, housing and rear bracket. The spacing washers shown in Figure 32 are used for adjustment of

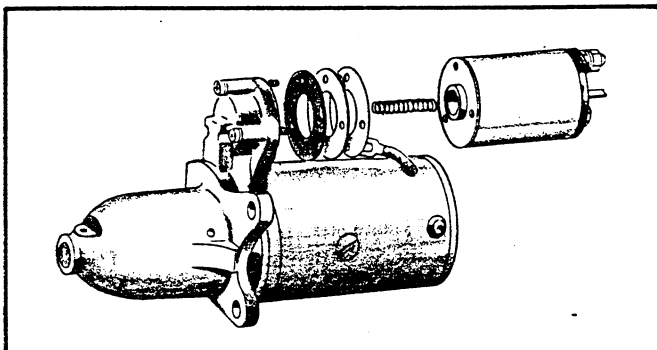


FIGURE 31. MAGNETIC SWITCH REMOVAL

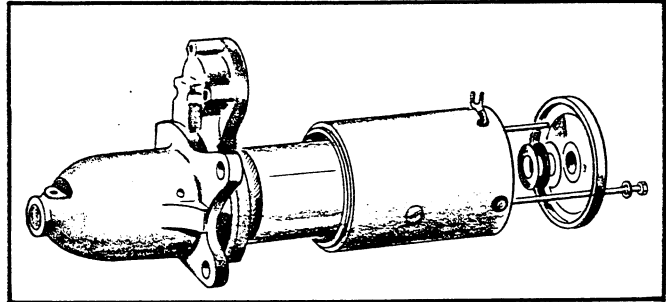


FIGURE 32. REMOVING THROUGH BOLTS

the thrust gap of the armature shaft and are placed between the rear bracket and the commutator.

NOTE: These washers are inserted so the steel washer is located in the commutator side.

3. The armature can easily be removed from the front bracket. Be careful not to miss a small steel washer used in the end of the armature shaft. The shift lever can be removed along with the armature when it is removed. In this case, the spring holder, lever springs and retainer can be taken out before the lever. See Figure 33.

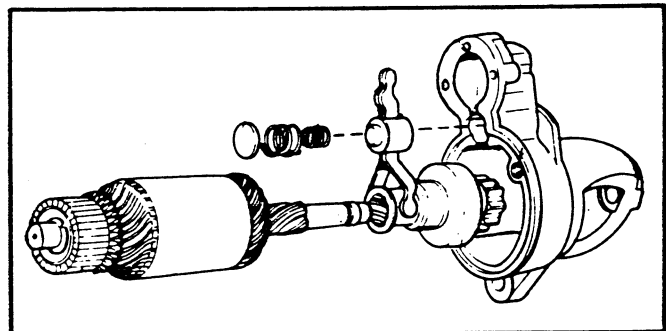


FIGURE 33. REMOVING ARMATURE

4. Remove the ring after driving the pinion stopper toward the pinion gear using a cylindrical tool as shown in Figure 34. The overrunning clutch and the pinion stopper should be removed simultaneously.
5. All four brushes have been soldered to the brushholder in the same way. The brush springs can be removed from the brushholder.
6. The pole shoes may be removed if necessary, by removing the flat head machine screws from the frame.

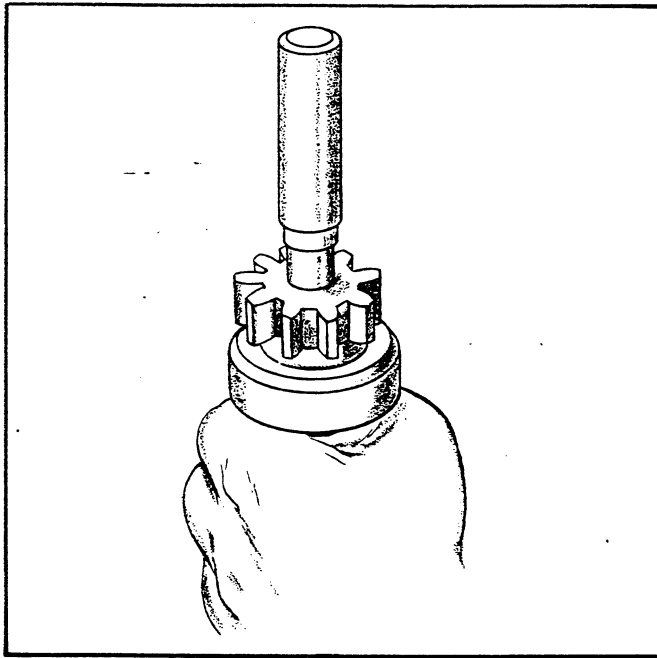


FIGURE 34. REMOVING RING

REASSEMBLY

Inspect the parts carefully in accordance with the procedure described in "Inspection of parts". Make any repairs necessary. Reassembly is the reverse of disassembly. The following precautions should be taken:

1. Clean all of the parts carefully with a dry cloth and compressed air if it is available.

NOTE: a. Bearing equipped parts must not be immersed in cleaning fluid. These parts should

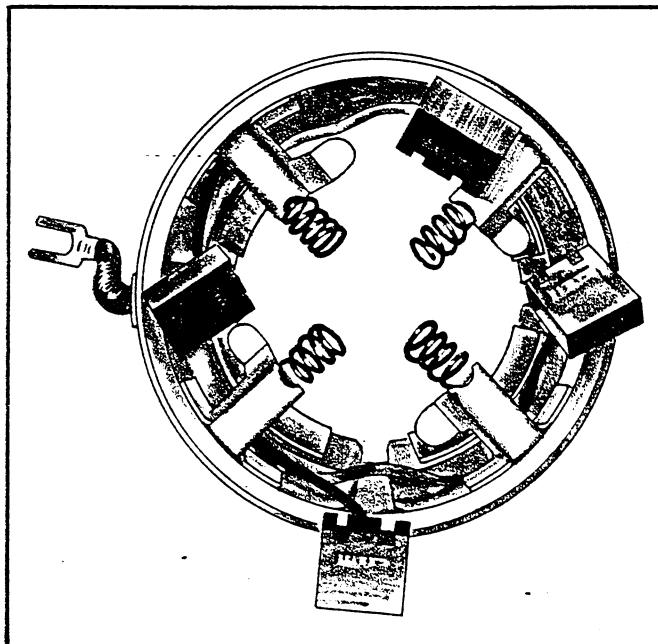


FIGURE 35. BRUSHES

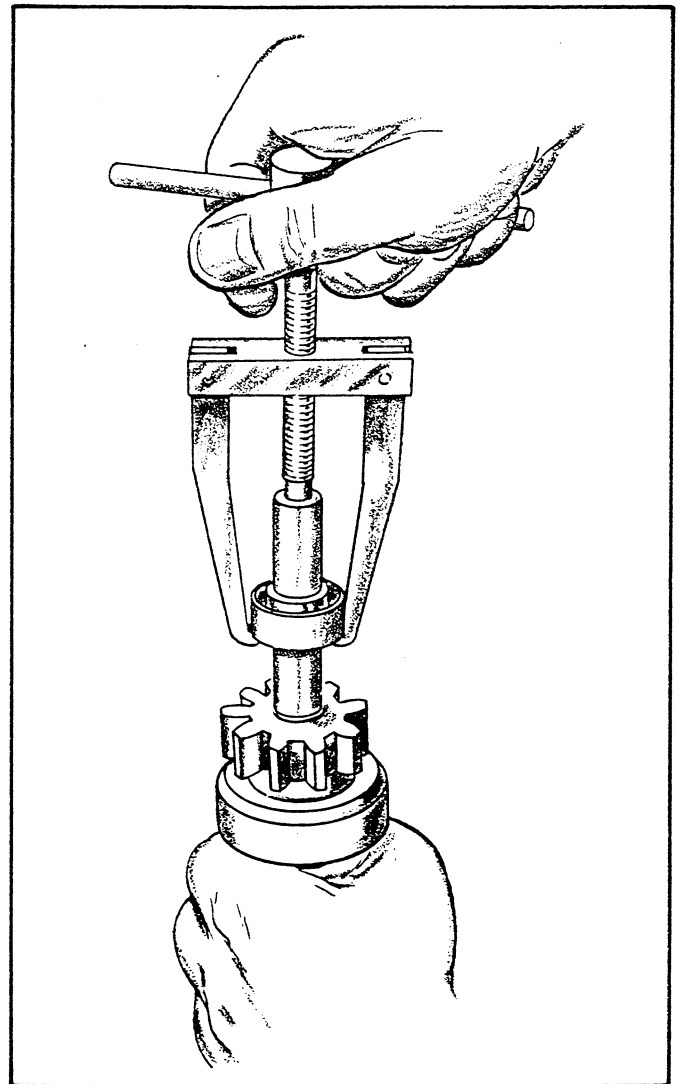


FIGURE 36. MOUNTING OVERRUNNING CLUTCH

be cleaned with a brush dipped in "Varsol" or any other comparable mineral spirits. b. Do not immerse overrunning clutch in cleaning solvent. c. Thoroughly dry any parts that have come into contact with the cleaning fluid.

2. Apply 20 weight non-detergent oil to the armature shaft and splines. Apply grease (Shell Albania No. 2 or equivalent) sparingly on the shift lever pin, the joint of the shift lever and plunger, the plunger and spacing washers at the end of the shaft.
3. To mount the overrunning clutch; first insert the pinion stopper into the armature shaft, then apply the ring to the groove of the shaft rigidly. For the insertion of the ring, use a tool as shown in Figure 36 and pull the pinion stopper up.
4. Use spacing washers to adjust the armature to give end play of .004" to .02".
5. Tighten the thru bolts to a torque of 35 to 44 in-lbs.
6. Insert the shift lever as shown in Figure 37 into the front bracket.

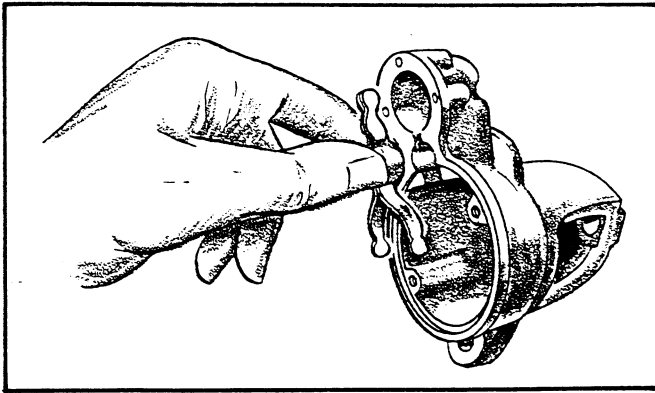


FIGURE 37. INSTALLING SHIFT LEVER

INSPECTION OF PARTS

1. **Testing armature for short circuits.** Place the armature in a growler and hold a thin steel blade parallel to the core and just above it per Figure 38 while slowly rotating the armature in the growler. A shorted armature will cause the blade to vibrate and be attracted to the core. Replace shorted armature.

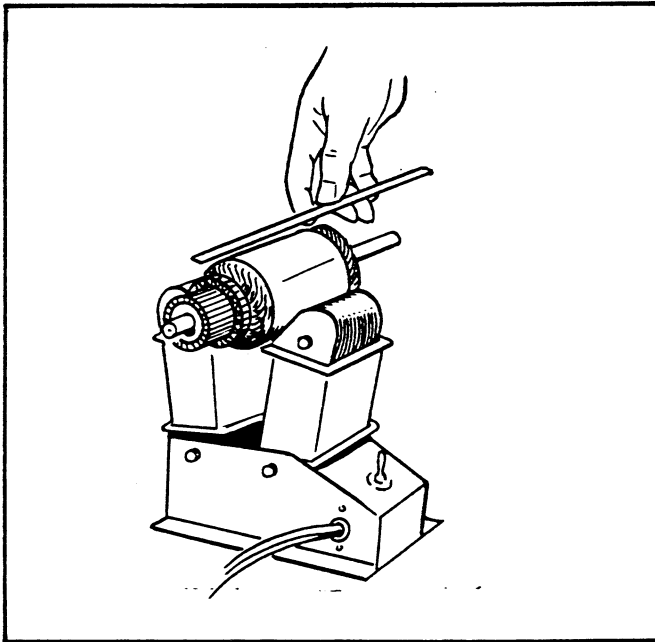


FIGURE 38. ARMATURE SHORT CIRCUIT TEST

2. **Testing Armature for Grounds.** Touch armature shaft or core and the end of each commutator bar with a pair of ohmmeter leads per Figure 39. If the ohmmeter reading is low, it indicates a grounded armature. Replace grounded armature.
3. **Testing Armature for Open Circuit.** The most likely place for an open circuit to occur is at the commutator riser bars. Inspect the points where the conductors are joined to the commutator bars for loose connections.
4. **Testing Commutator Runout.** Place armature in a test bench and check runout with a dial indicator per Figure 40. When commutator runout exceeds .004", commutator should be refaced.

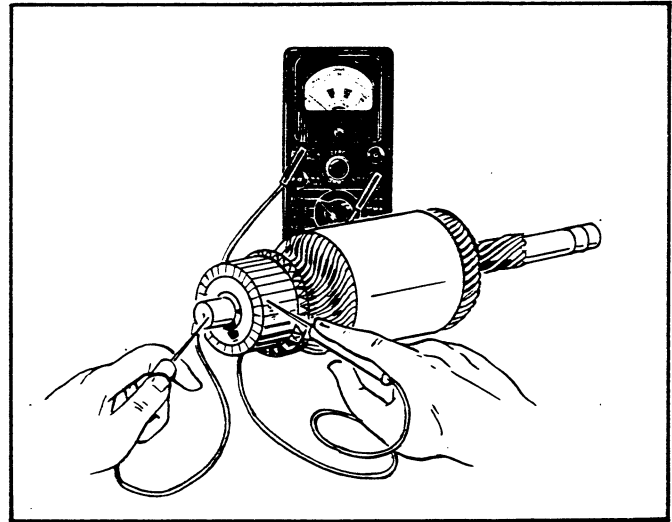


FIGURE 39. ARMATURE GROUND TEST

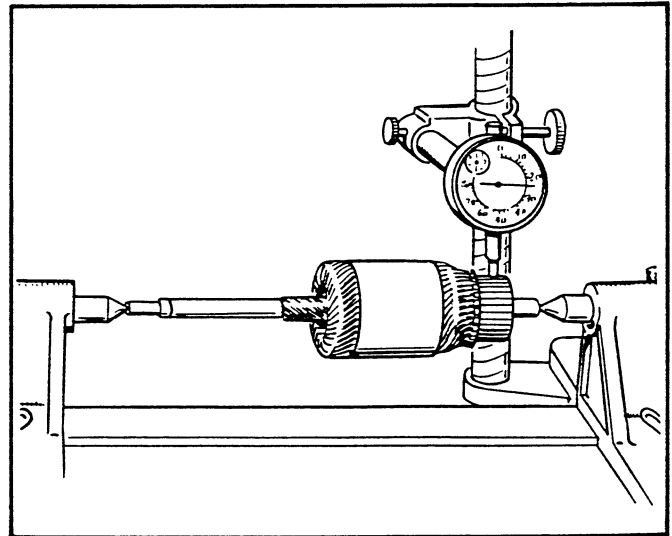


FIGURE 40. CHECKING COMMUTATOR RUNOUT

5. **Testing Armature Shaft Runout.** The armature shaft as well as the commutator may be checked. See Figure 41. A bent armature often may be straightened, but if the shaft is worn, a new armature is required.

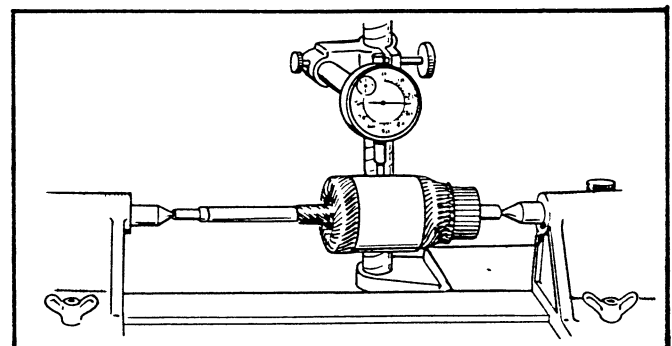


FIGURE 41. CHECKING ARMATURE SHAFT RUNOUT

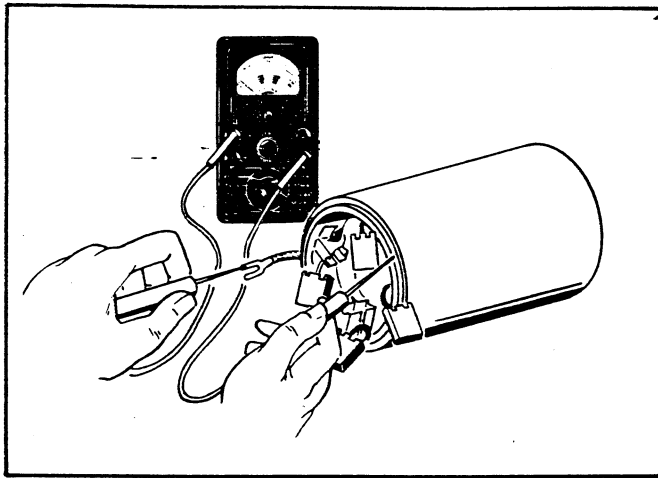


FIGURE 42. FIELD COIL GROUND TEST

6. **Testing Field Coils For Grounds.** Referring to Figure 42, place one lead on the connector and the other on a clean spot on the frame after unsoldering shunt field coil wire. If the ohmmeter reading is low, the fields are grounded, either at the connector or in the windings.
7. **Testing Field Coils For Open Circuit.** Place one lead on the connector and the other on a clean spot on the brush holder per Figure 43. If the ohmmeter reading is high, the field coil is open. Check the other three brush holders in the same manner.

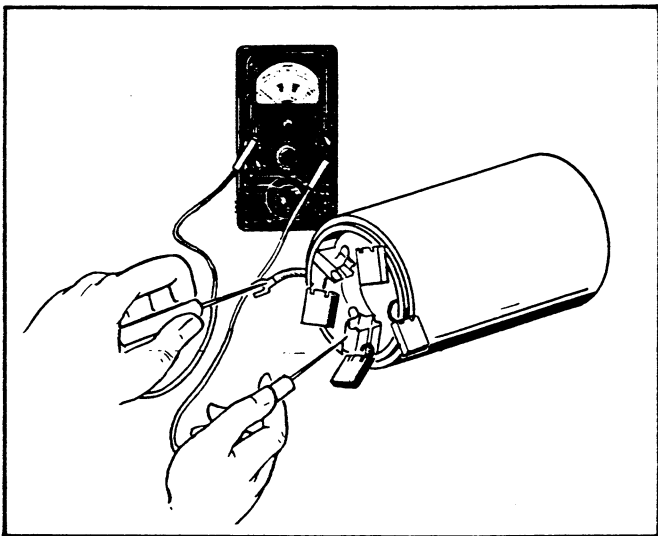


FIGURE 43. FIELD COIL OPEN CIRCUIT TEST

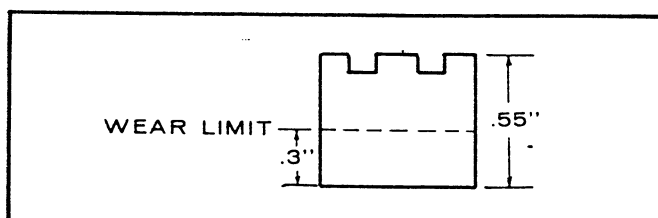


FIGURE 44. BRUSH WEAR LIMIT

8. **Inspection of Brushes.** When brushes are worn more than .3" they are to be replaced. Figure 44 shows the wear limit. See that the brushes move smoothly in the brush holders.
9. **Inspection for Brush Spring Tension.** Measure brush spring tension with a tension meter as shown in Figure 45. Push the brush and take a reading just as the brush projects a little from the brushholder. On a new brush the spring tension should be 29 to 38 ounces.

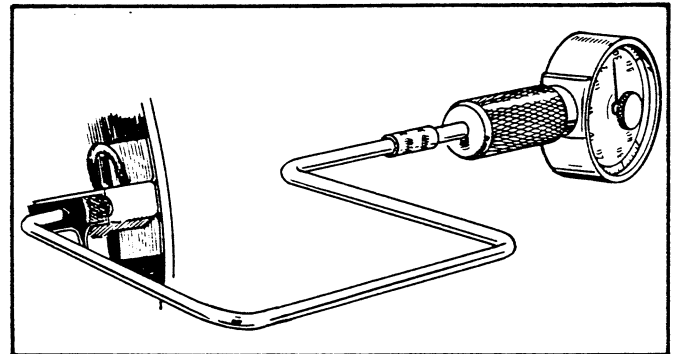


FIGURE 45. BRUSH SPRING TENSION TEST

INSPECTION AFTER OVERHAUL

1. For no load test, the starting motor is wired as shown in Figure 46 and revolved. The value of the meter reading at this condition should be as follows:

Voltage	11.5 volt
Current Draw	60 amp maximum

NOTE: The conductor for this test should be large enough and as short as possible. If anything

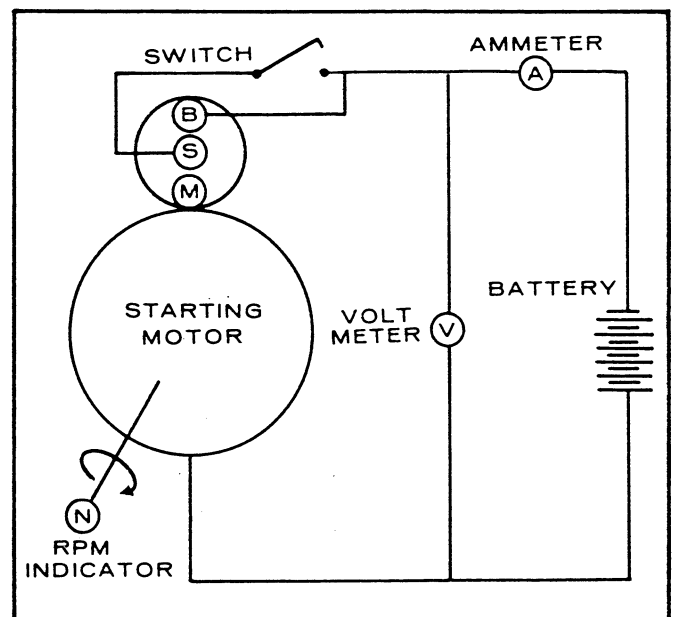


FIGURE 46. STARTING MOTOR WIRING

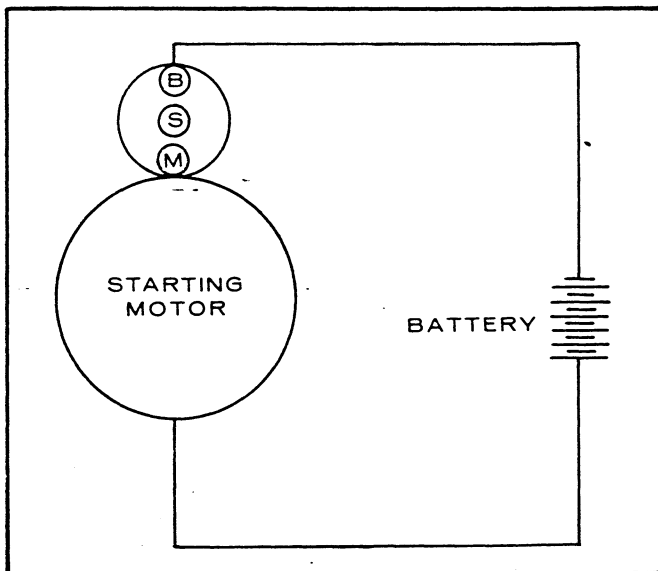


FIGURE 47. BATTERY CONNECTIONS

is wrong in the above test, inspect the following items:

- Annealed brush springs
- Improperly seated brushes
- Insufficient armature endplay
- Shorted, open or grounded armature
- Grounded or open field coil
- Poor electrical connection
- Dirty commutator

2. **Adjusting Pinion Clearance.** Connect the battery to the starting motor as shown in Figure 47. This will allow the pinion of the starting motor to slide and stop. In this state, measure the clearance between the end of the pinion and pinion stopper when the pinion is pushed lightly toward the commutator end. Clearance should be .02" to

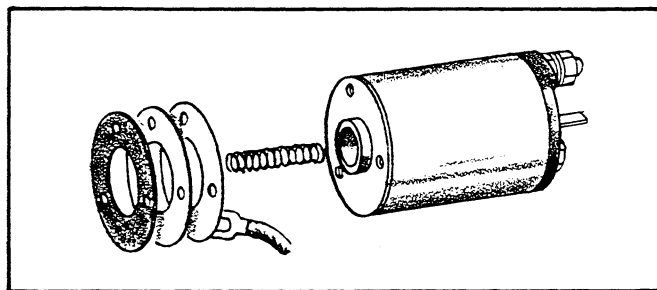


FIGURE 48. ADJUSTING PINION CLEARANCE

.06". Adjust for proper clearance by removing the magnetic switch attaching screws and select the proper thickness of the fiber packings shown in Figure 48.

READI-PULL STARTER

Refer to Figure 49 showing the Read-Pull manual starter disassembled.

WARNING

The recoil spring may unwind and cause injury if let fly wildly when starter is disassembled or reassembled.

The sheave hub bearing (16) has a recess which was packed full of grease at the factory. Normally, no additional lubrication is required. However, if the starter is disassembled for some other reason, add grease to the bearing and to the spring pawls (11) where they contact the ratchet arm (13).

To install a new rope or internal parts, remove the starter from its mounting ring by removing the four clamping screws.

To install a new rope, rotate the sheave (10) with

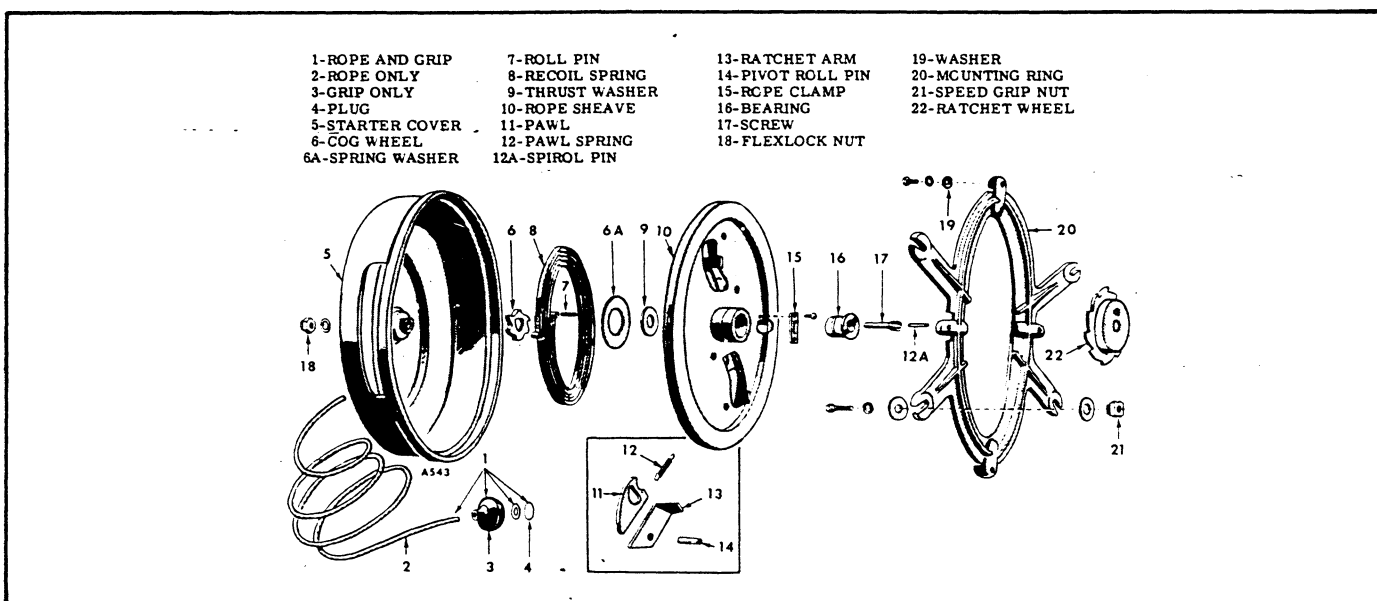


FIGURE 49. READI-PULL STARTER

crankshaft rotation direction to fully tighten the spring (8), back up only as necessary to align the hole in the sheave with the slot in the cover (5), clamp the rope to the sheave, then when released, the rope will wind on the sheave.

To install a new recoil spring, remove the sheave from the cover. Wind the spring, with its rivet heads outward, forming a coil small enough to be inserted in the recess of the starter cover. It may be necessary to tie the spring with a piece of wire to prevent its unwinding during installation unless other help is available. Place the spring in the cover recess in crankshaft rotation direction. Remove the tying wire if used. While holding the spring to prevent its unwinding, install the inside end of the spring on the roll pin (7) in the cover. With the pull rope removed, install the sheave assembly in the cover so that the tab on the sheave enters the outside end loop of the recoil spring. Be sure the thrust washer (9) is in place. Then install the pull rope.

Spring breakage is much less common than spring fatigue due to long usage. In either case, the spring should be replaced. Cleaning and lubricating the pawls and ratchet arms in the rope sheave will improve a sluggish acting recoil. To temporarily extend the life of a fatigued spring, try rewinding it *inside out* (rivet heads inward).

To install a ratchet arm (13) in the sheave, the pawl (11) must first be removed. The ratchet arm will fit in only the correct position. The spring pawl must be installed with its flat edge against the ratchet arm.

The anti-backlash cogwheel (6) is an easy press fit on the starter cover.

INSTALLING THE READI-PULL STARTER

See that the engine blower housing is in good condition. If the mounting holes are worn or if the blower housing is otherwise damaged, replace it with a new one. Refer to Figure 50. .

1. Install the new ratchet (1) against rope sheave (11) using lock washer (10) and flywheel mounting screw (9). Discard the large flat washer from engines so equipped. Engage drive hole with flywheel boss.
2. Four special nuts are supplied for mounting the starter to the blower housing. If the blower housing is not already fitted with similar nuts, remove the blower housing and install the nuts as shown in detail A. Reinstall the blower housing, tightening securely in place.
3. Install centering pin (12) in starter center screw (14) allowing 3/8" to protrude. For reinstallations, readjust pin depth.

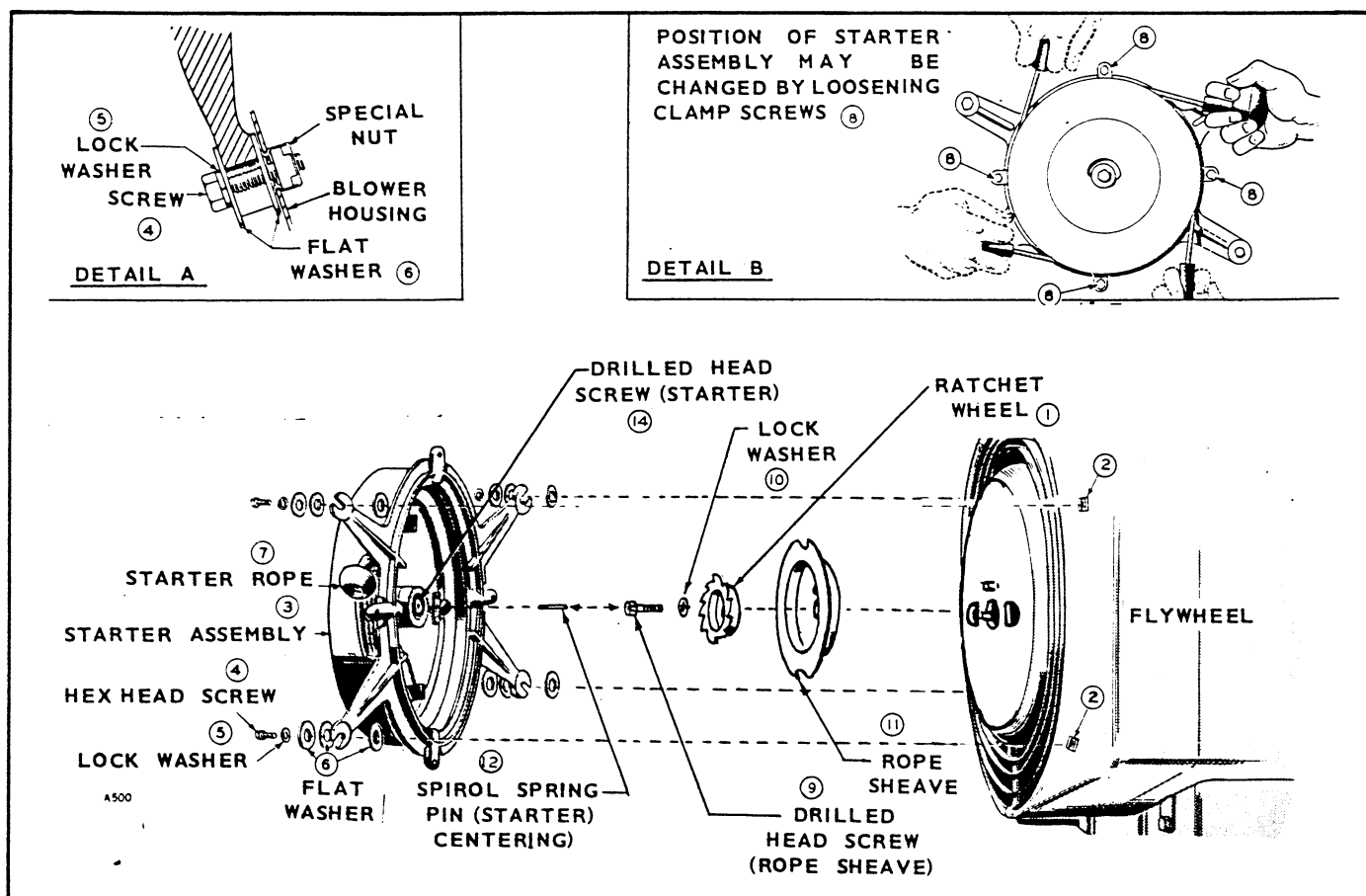


FIGURE 50. STARTER INSTALLATION

4. Center the starter assembly over the ratchet wheel with the centering pin engaging the center hole of the flywheel mounting screw. While holding in position, mount the starter, using a hex head screw, lock washer and two flat washers at each mounting arm as shown in detail A. Tighten the mounting screws securely.
5. The direction of pull on the starter rope is ad-

justable to fit the requirements of the individual installation. See detail B. To change the direction of pull, loosen the four clamp screws (8) and turn the starter in its mounting ring to the desired position. Tighten the four clamp screws securely. Try the starter several times, making sure that the pull rope will not rub against one of clamping screws.

OIL SYSTEM

The NH engine has pressure lubrication to all working parts. The oil system includes:

- Oil intake cup
- Gear type oil pump
- Oil pressure gauge
- Full flow oil filter
- Oil passages to deliver oil throughout the engine

The oil pump is located on the front surface of the crankcase and is driven by the crank gear. The inlet pipe and screen assembly is attached directly to the pump body. A discharge passage in the cover of the pump registers with a drilled passage in the crankcase. All of the oil from the pump flows through this passage to the oil filter and is then returned to the galleries in the block. Parallel passages distribute oil to the front main bearing, rear main bearing and pressure control bypass valve.

Circumferential grooves in the main bearings supply oil to the connecting rod bearings through drilled passages from each main journal.

A drilled passage connects the front main bearing oil supply to the front camshaft bearing. The flyball governor is lubricated by a drilled passage in the front camshaft journal.

The oil overflow from the bypass valve furnishes lubrication to the camshaft drive gears.

Normal oil pressure should be 30 psi or higher when the engine is at operating temperature. If pressure drops below 30 psi at governed speed, inspect the oil system for faulty components.

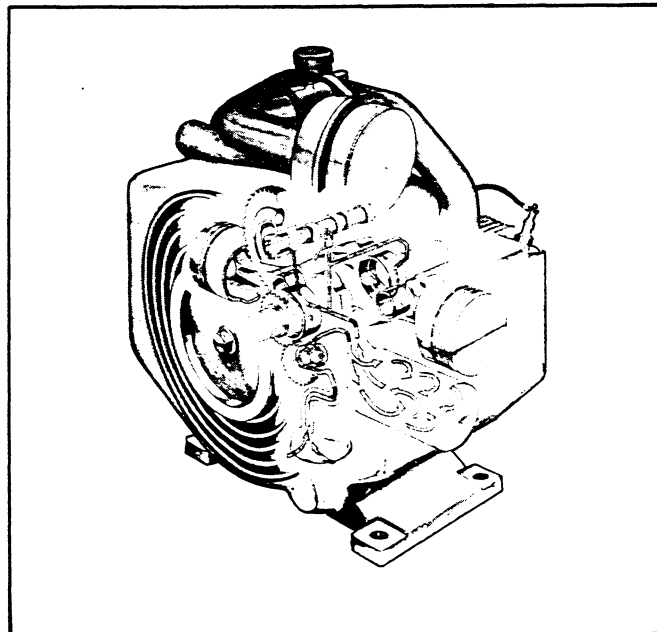


FIGURE 51. OIL SYSTEM

OIL PRESSURE GAUGE

Located in the upper right hand corner of the engine shroud. Before replacing, check for clogged oil passage behind the gauge. Remove it with a wrench and replace with a new gauge if faulty.

Refer to the Service and Maintenance Section for instructions covering the oil filter and the ball check crankcase breather.

ENGINE DISASSEMBLY

If engine disassembly is necessary, observe the following order (i.e. Flywheel, Gear Cover. . .). As disassembly progresses, the order may be changed as will be self evident. The engine assembly procedure is the reverse of disassembly. Any special assembly instructions for a particular group are included in the applicable section. When reassembling, check each section for these special assembly instructions or procedures. See Figure 52.

FLYWHEEL

To remove the flywheel, turn the flywheel mounting screw outward about two turns and use Onan Pulley 420A100 to pull the flywheel.

Do not drop the flywheel. A broken fin will destroy the balance. Always use a steel key for mounting the flywheel.

A magneto flywheel which has lost its magnetism can be remagnetized. The spark should jump a 3/16" gap with ease, as tested by holding the spark plug wire away from a clean metal part of the engine while cranking.

GOVERNOR CUP

With the gear cover removed, the governor cup can be taken off after removing the snap ring from the camshaft center pin. Catch the flyballs while sliding the cup off. See Figure 53.

Replace any flyball that is grooved or has a flat spot. If the arms of the ball spacer are worn or otherwise damaged, replace the entire timing gear set. The governor cup must spin freely on the camshaft center pin without excessive looseness or wobble. If the race surface of the cup is grooved or rough, replace it with a new one.

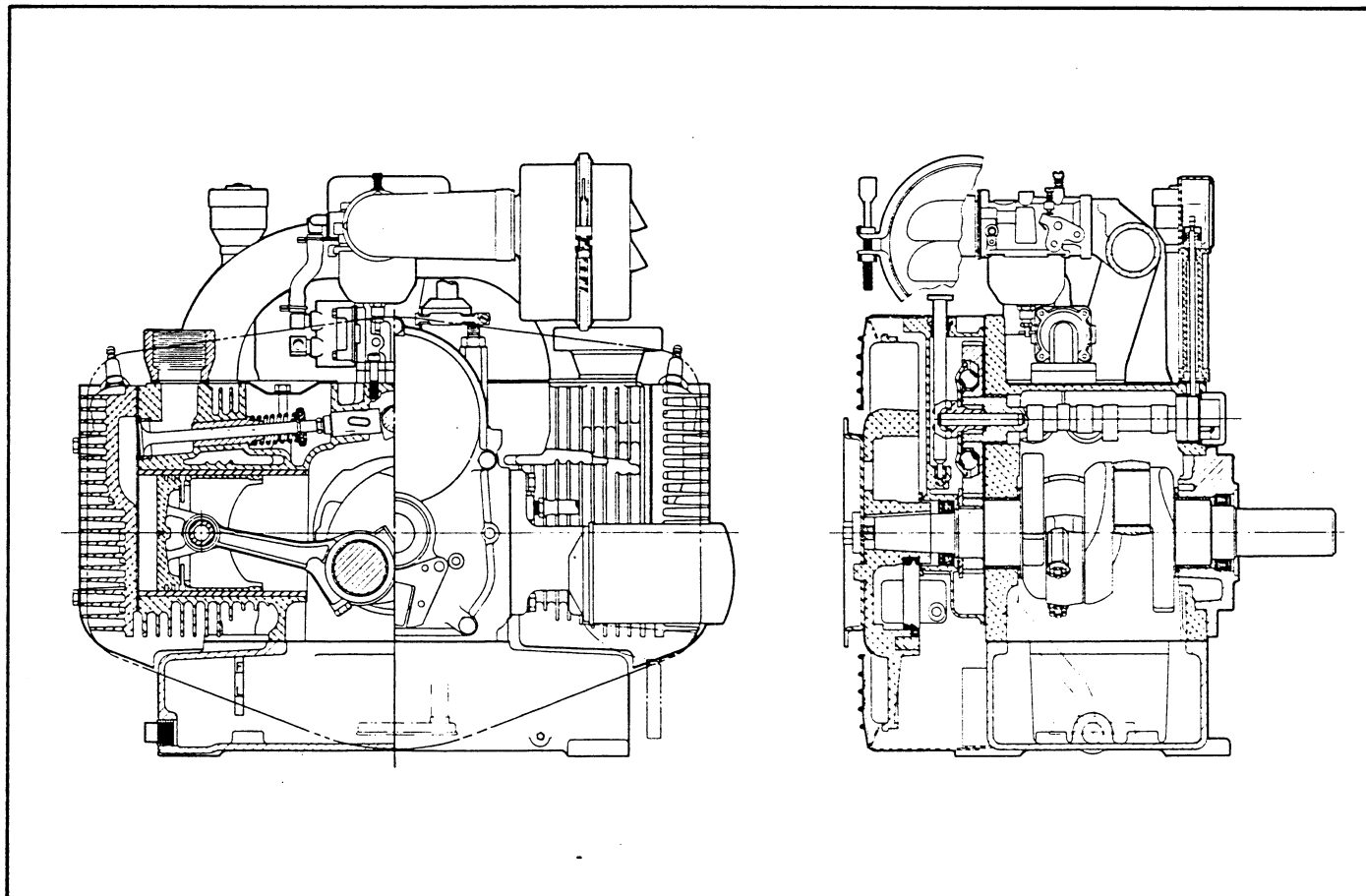


FIGURE 52. ENGINE ASSEMBLY

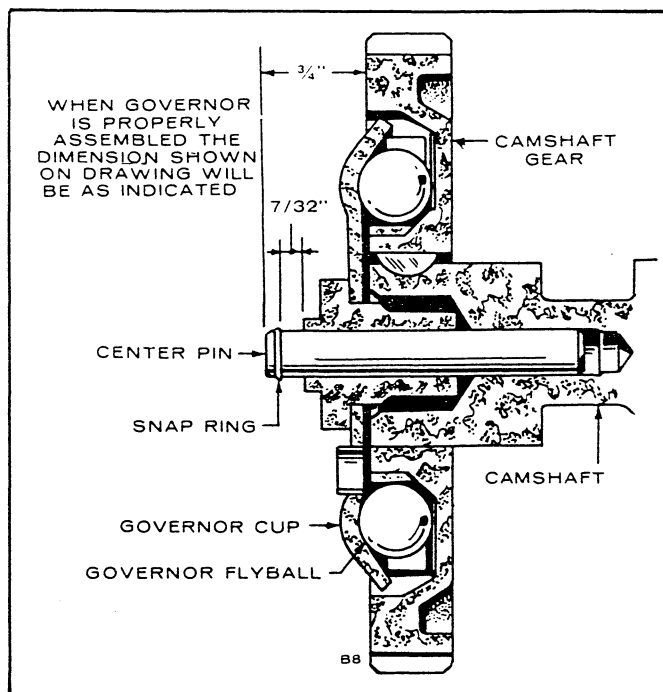


FIGURE 53. GOVERNOR CUP DETAILS

When installing the governor cup, tilt the engine so the gear is up, put the flyballs in place and install the cup and snap ring on the center pin (Figure 53).

The camshaft center pin extends out $\frac{3}{4}$ " from the end of the camshaft. This distance provides an in and out travel distance of $\frac{7}{32}$ " for the governor cup, as illustrated. Hold the cup against the flyballs when measuring. If the distance is less (the engine may race, especially at no load), remove the center

pin and press a new pin in only the required amount. Otherwise, grind off the hub of the cup as required. The camshaft center pin cannot be pulled outward nor removed without damage. If the center pin extends out too far, the cup will not hold the flyballs properly.

GEAR COVER

After removing the flywheel key and mounting screws, tap the gear cover gently with a soft-faced hammer to loosen it.

CAUTION When installing the gear cover, make sure that the pin in the gear cover engages the metal lined (smooth) hole in the governor cup.

Turn the governor cup so that the metal lined hole is at the three o'clock position. The smooth side of the governor yoke must ride against the governor cup. Turn the governor arm and shaft clockwise as far as possible and hold in this position until the gear cover is installed flush against the crankcase. Be careful not to damage the gear cover oil seal. Adjust the roll (stop) pin to protrude to a point $\frac{3}{4}$ " from the cover mounting surface. See Figure 54.

TIMING GEARS

If replacement of either the crankshaft gear or the camshaft gear becomes necessary, install both gears

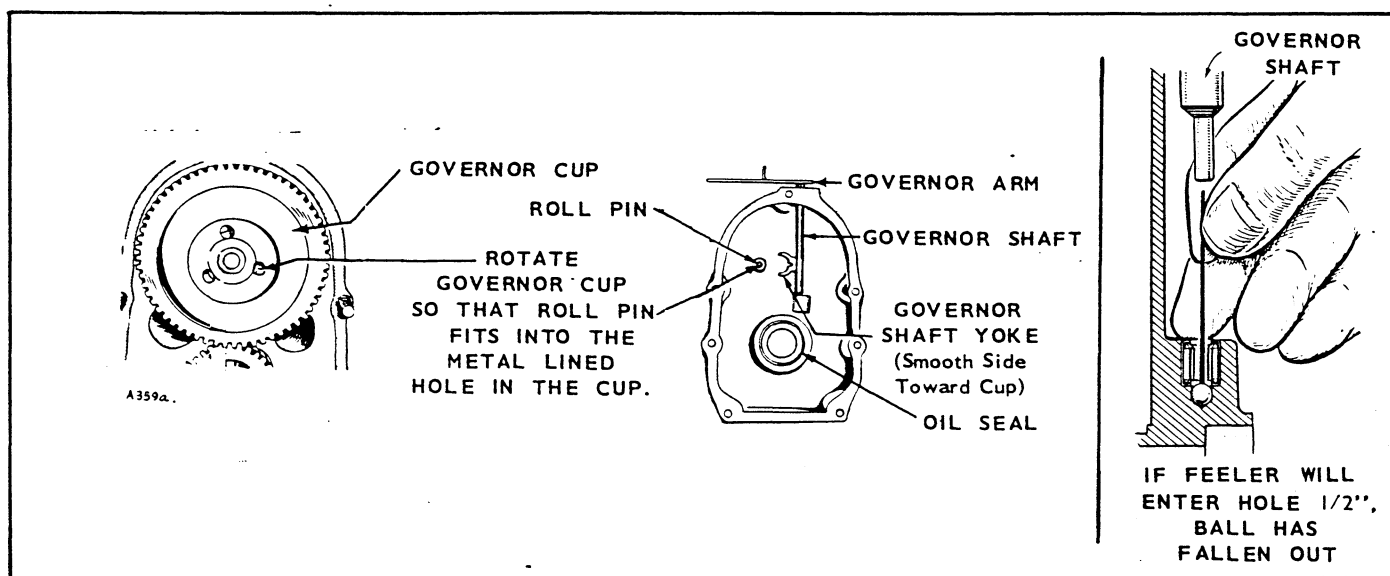


FIGURE 54. GEAR COVER ASSEMBLY

new, never one only. Use a gear pulling ring (#420A-248) to remove the crankshaft gear. Be sure to remove the snap ring first.

The camshaft gear is pressed on and keyed to the camshaft. The camshaft and gear must be removed as an assembly after first removing the crankshaft gear lock ring and washer. Before removing the camshaft and gear assembly, remove the cylinder head and valve assemblies. Remove the operating plunger for the breaker points. Remove the fuel pump and tappets.

The camshaft may be pressed out of the gear by use of a hollow tool or pipe which will fit over the camshaft center pin. Do not press on the center pin or damage it in any way. The governor ball spacer is a press fit to the camshaft gear.

When pressing a camshaft gear onto the camshaft, be sure the gear is started straight and that the key is properly in place. When replacing the cam gear on units having automatic spark advance mechanisms, remove the spark advance mechanism and put blocks beside the pins to avoid damage when pressing on cam gear. Install the governor cup assembly before installing the camshaft and gear in the engine.

Each timing gear is stamped with an O mark near the edge. The gear teeth must mesh so that these marks coincide exactly when the gears are installed in the engine (Figure 55). Be sure, when installing the camshaft gear and shaft assembly, that the thrust washer is properly in place behind the camshaft gear. Replace the camshaft retaining washer and lock ring to the crankshaft.

CYLINDER HEADS

The cylinder head should be tightened in the order designated per Figure 56 to a torque of 17 to 19 foot pounds, with the cylinder head at room temperature.

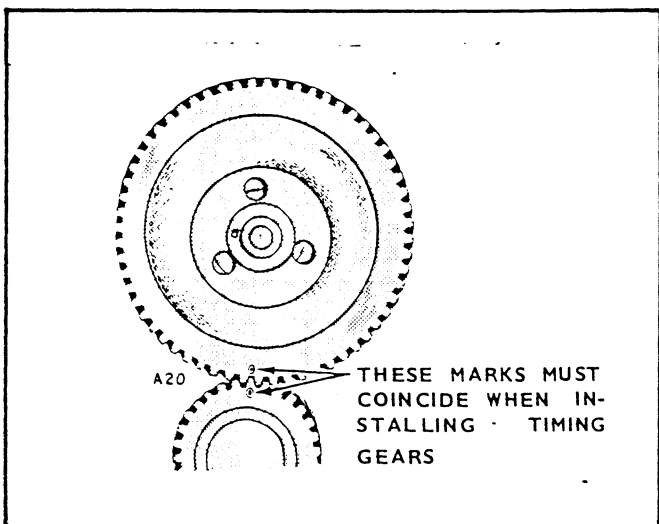


FIGURE 55. TIMING-GEAR REMOVAL AND INSTALLATION

At some later time, after the engine has been operated so it has reached normal hot temperature and allowed to cool to room temperature, the cylinder head bolts should be tightened again to 17-19 foot pounds torque. This retightening should be done before the engine has been run a total of fifty operating hours.

NOTE: Beginning Spec C, cylinder head flat washers are also used with the cylinder head nuts.

VALVES

Properly seated valves are essential to good engine performance. The cylinder head is removable for valve servicing. Do not use a pry to loosen the cylinder head. Rap sharply on the edge with a soft-faced hammer, taking care not to break any cooling fins. A conventional type valve spring lifter may be used when removing the valve spring locks, which are of the split type. Clean all carbon deposits from the cylinder head, piston top, valves, guides, etc. If a valve face is burned or warped, or the stem worn, install a new valve.

Worn valve stem guides may be replaced from inside the valve chamber. A seal is provided behind the intake valve guides only. The smaller diameter of the tapered valve guides must face toward the valve head.

Tappets are also replaceable from the valve chamber, after first removing the valve assemblies.

The valve face angle is 44°. The valve seat angle is 45°. This 1° interference angle results in a sharp seating surface between the valve and the top of the valve seat. The interference angle method of grinding valves minimizes face deposits and lengthens valve life (Figure 57).

The valves should not be hand lapped, if at all avoidable, since the sharp contact may be destroyed. This

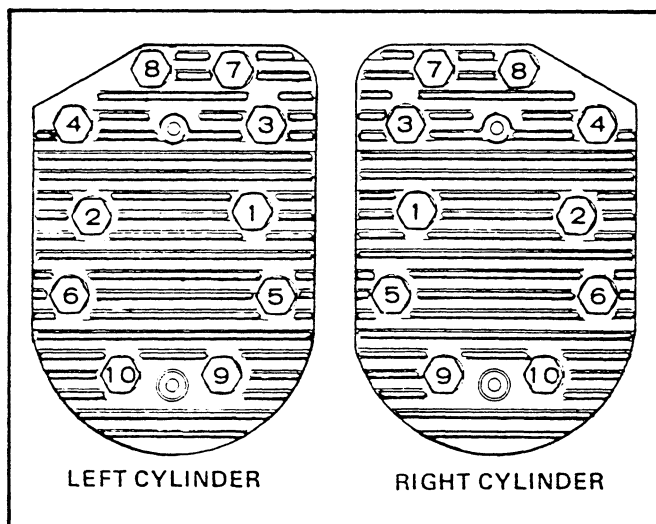


FIGURE 56. HEAD BOLT TIGHTENING SEQUENCE

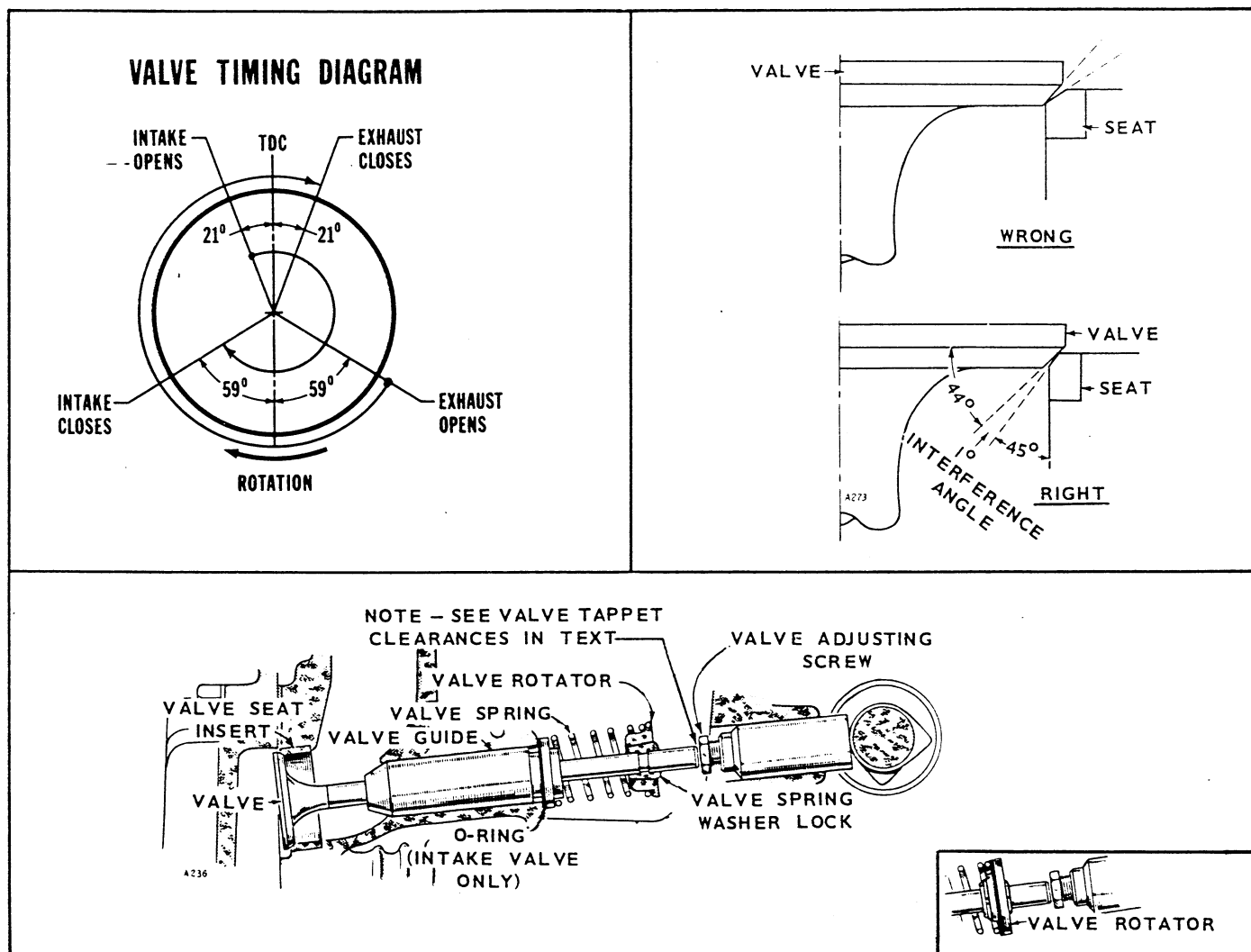


FIGURE 57. VALVES

is especially important where stellite faced valves and seats are used. Valve faces should be finished in a machine to 44° . Valve seats should be ground with a 45° stone and the width of the seat band should be $1/32$ to $1/8$ of an inch wide. Grind only enough to assure proper seating.

Remove all grinding compound from engine parts and place each valve in its proper location. Check each valve for a tight seat, using an air pressure type testing tool. If such a tool is not available, make pencil marks at intervals across the valve face and observe if the marks rub off uniformly when the valve is rotated part of a turn against the seat.

Lightly oil the valve stems and reassemble all parts removed. Adjust the valve clearance.

The positive type valve rotocoils serve to prolong valve life and decrease valve repairs. Check the rotocoils periodically by removing the cylinder heads and cranking the engine. When functioning properly, the valve is rotated a fraction of a turn each time

it opens. If rotocoils are faulty, install new ones.

EXHAUST PORT INSERTS (BEGIN SPEC C)

Inserts are located in each cylinder's exhaust port. If the manifold is removed, the inserts can be taken out or fall out if the block is turned upside down. Be sure to replace them before the manifold is reattached. See Figure 58.

CAUTION *It's extremely important the inserts are in the exhaust ports. The ports have been machined and the inserts included at the factory to play an important function in exhaust heat transfer.*

PISTONS AND RINGS

Whenever there is a noticeable wear ridge at the top of each cylinder, remove the ridge with a ridge reamer before removing the pistons. If not, the rings can catch the ridge when pushing out the pistons and cause a ring land fracture. See Figure 59.

To remove the piston and connecting rod assemblies,

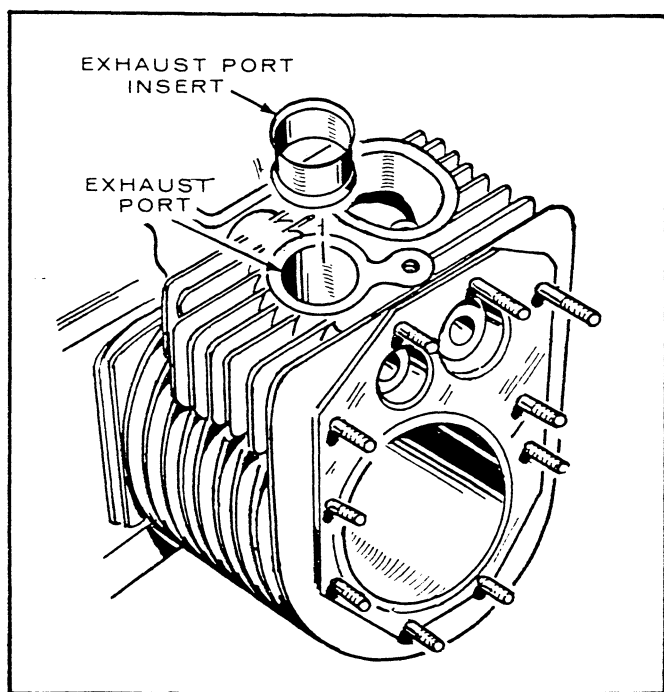


FIGURE 58. EXHAUST PORT INSERT (BEGIN SPEC C)

turn the crankshaft until a piston is at the bottom of the stroke. Remove the nuts from the connecting rod bolts. Lift the rod bearing cap from the rod and push the rod and piston assembly out the top of the cylinder with the handle end of a hammer. Be careful not to scratch the crankpin or the cylinder wall when removing these parts.

NOTE: Keep the connecting rod bearing caps and bearings with their respective rods.

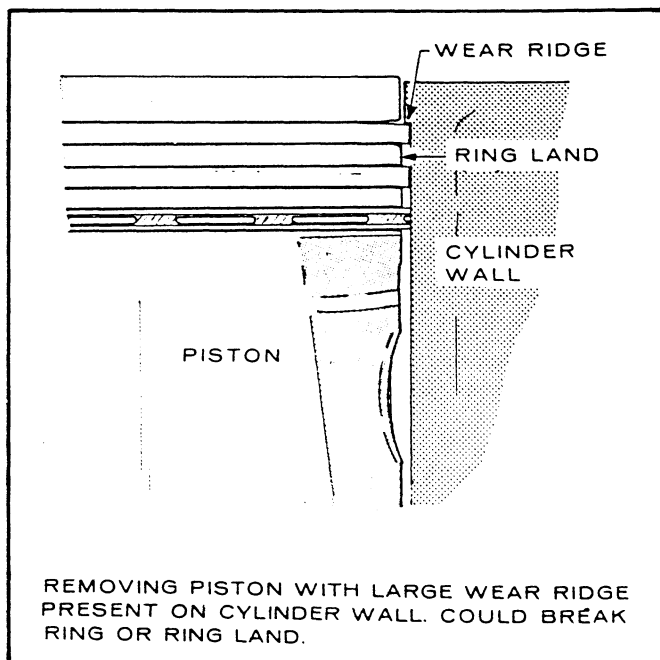


FIGURE 59. WEAR RIDGE ON CYLINDER WALL

The pistons are fitted with two compression rings and one oil control ring with an expander. Remove these rings from the piston using a piston ring spreader (Onan 420P146).

Clean the piston ring grooves with a groove cleaner or the end of a broken ring filed to a sharp point (See Figure 60). All passages should be cleaned with a non-caustic solvent. Clean the rod bore and the back of the connecting rod bearings thoroughly.

Mark each piston to make sure the rod will be assembled on the piston from which it was removed. Remove the piston pin retainer from each side and push the pin out.

Inspect the pistons for fractures at the ring lands, skirts and pin bosses. Check for wear at the ring land using new rings and a feeler gauge as shown in Figure 61. See Dimensions and Clearances for proper side clearance measurement and ring groove widths.

Improper width rings or excessive ring side clearance

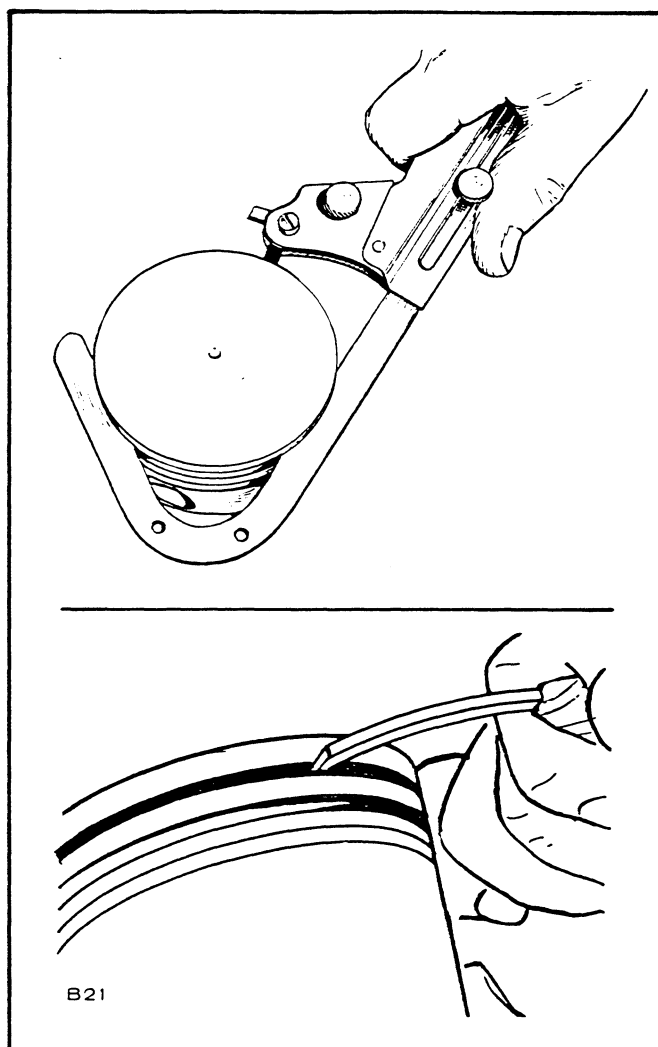


FIGURE 60. CLEANING RING GROOVES

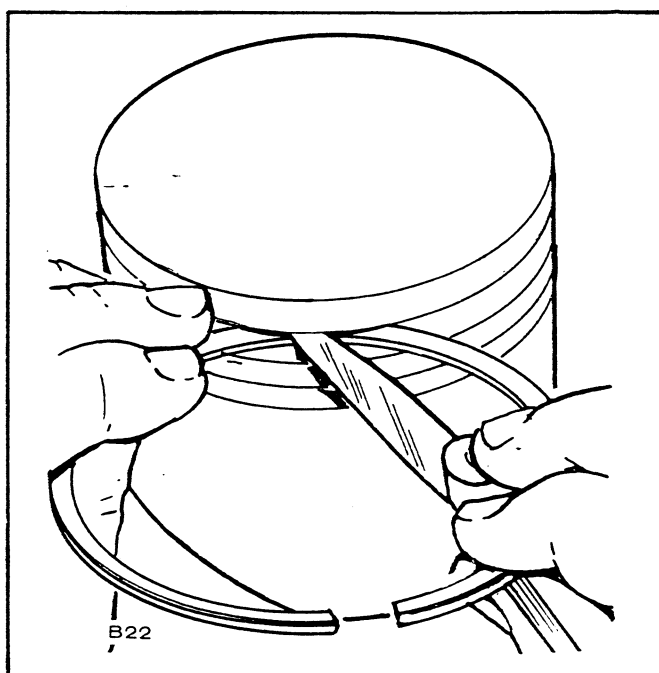


FIGURE 61. RING LAND INSPECTION

can result in ring breakage. New rings in worn ring grooves don't have good cylinder wall contact (Figure 62).

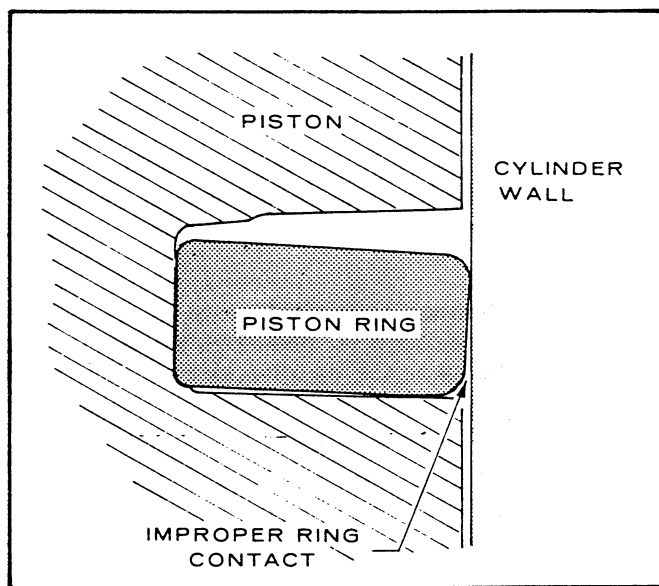


FIGURE 62. NEW RING IN WORN RING GROOVE

Replace pistons showing signs of bad scoring or burring, excessive skirt clearance, wavy or worn ring lands, fractures or damage from detonation. Replace piston pins showing fractures, scored bores or bores out of round more than 0.002".

Use a new piston pin to check the pin bushing in the connecting rod for wear. The clearance should be as shown in Dimensions and Clearances.

Before installing new rings on the piston, check the ring gap by placing each ring squarely in its cylinder at a position corresponding to the bottom of its travel (see Figure 63). The gap between the ends of the ring is given in Dimensions and Clearances. Rings which are slightly oversize may be filed as necessary to obtain the correct gap, but do not use rings which require too much filing. Standard size rings may be used on .005" oversize pistons. Rings that are .010", .020", .030" and .040" oversize are to be used on corresponding oversize pistons. Rings of the tapered type are usually marked *top* on one side, or identified in some other manner and the ring must be installed with this mark toward the closed end of the piston.

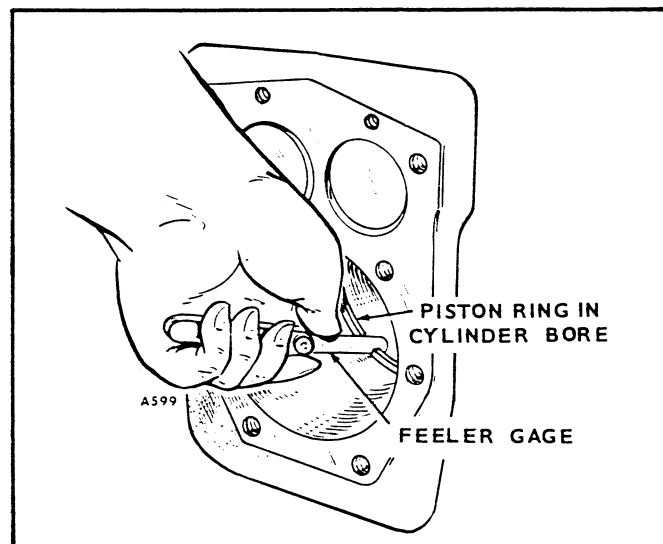


FIGURE 63. FITTING PISTON RINGS TO THE CYLINDER

Space each ring gap one third of the way around the piston from the preceding one, with no gap directly in line with the piston pin. The bottom piston ring groove should be fitted with an expander and an oil control ring and the two upper grooves fitted with compression rings. If a chrome faced ring is used, it will be in the top groove. The oil control ring is selected for best performance in regard to the correct unit pressure characteristics.

The piston is fitted with a full-floating type piston pin. The pin is kept in place by two lock rings in the piston, one at each side. Be sure these lock rings are properly in place before installing the piston and connecting rod in the engine. Refer to Dimensions and Clearances for the correct piston-to-cylinder clearance.

CONNECTING RODS

The connecting rods should be serviced at the same time the pistons or rods are serviced. Rods must be removed with the piston. Replaceable bushings and bearings are used. Bearings are available in standard or .002", .010", .020" or .030" undersize.

Proper clearance is obtained by replacing the pin bushing and the bearings. The rod bearings are precision size and require no reaming.

Install the connecting rods and caps with raised lines (witness marks) aligned and with the caps facing toward the oil base. The rod and cap numbered 2 fits on the crankshaft journal nearest the bearing plate. Coat the crankshaft journal bearing surfaces with oil before installing the rods. Crank the engine by hand to see that the rods are free. If necessary, rap the connecting rod cap screws sharply with a soft-faced hammer to set the rod square on the journal.

CRANKSHAFT

Inspect the bearing journals. If they are scored and cannot be smoothed out by dressing down, the bearing journals should be refinished to use nearest available undersize bearings or a new crankshaft should be installed. If a worn main bearing journal cannot be fitted with an available precision type undersize bearing, then refinish it to the next undersize. If a worn rod journal cannot be fitted by installing new bearing inserts (forged rod), then refinish it to take the corresponding undersize bearing insert available.

Whenever making major repairs on the engine, always inspect the drilled passages of the crankshaft. Clean them to remove any foreign material and to assure proper lubrication of the connecting rods.

BEARINGS

Removal of the camshaft or crankshaft bearings requires complete disassembly of the engine. Use a press or a suitable drive plug to remove the bearings. Support the casting to avoid distortion and avoid damaging the bearing bore during removal and installation. Use oil on the bearings to reduce friction when installing and again lubricate with oil after installing (see Figure 64). Use combination bearing driver 420B324 to install the camshaft bearings.

Replacement camshaft bearings are precision type which do not require line reaming or line boring after installation. Coat the bearing with lubricating oil to reduce friction. Place the bearing on the crankcase over the bearing bore with the lubricating hole (front only) in proper position. Be sure to start the bearing

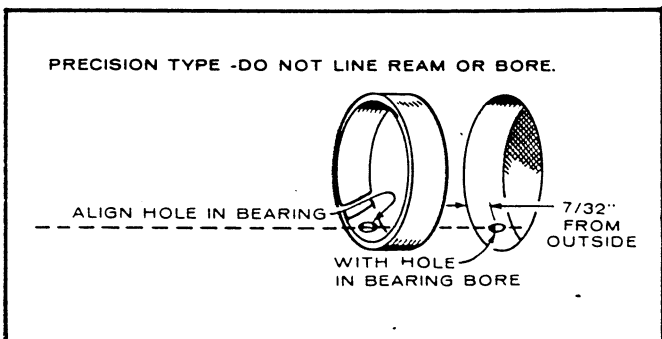


FIGURE 64. CAMSHAFT BEARING

straight. Press the front bearing in flush with the outside end of the bearing bore. Press the rear bearing in until past the ignition plunger hole.

New crankshaft main bearings are precision type which do not require line reaming or line boring after installation. They are available in standard size, .002", .010", .020" or .030" undersize.

Before putting in the main bearings, expand the bearing bore by placing the casting in hot water or in an oven heated to 200°F. If practical, cool the precision bearing to shrink it.

For putting in either the front or rear main bearing, using instructions following, always align the oil hole(s) in the bearing with the oil hole(s) in the bearing bore. The oil passage must be at least 1/2 open.

The cold oiled precision bearing should require only light taps to position it.

NOTE: Earlier units had thrust washer bearings and main bearings on front and rear of the engine. Current engines use a thrust washer and main bearing for the rear bearing plate while the front of the engine uses a one piece bearing. All engines should now use the new one piece bearing for overhaul or repair, discarding the thrust washer.

In the rear bearing plate, install the bearing flush to 1/64" below the end of the bore using combination driver 420B324 (same one used for camshaft bearing). See Figure 65.

NOTE: If the special combination tool isn't available, it's necessary to remove the lock pins with side cutters or Easy Out tool. After the new bearings are installed, insert new lock pins.

Before installing the front bearing (Figure 66), use the Locktite Bearing Mount furnished in the bearing kit. Use the towelette in the package to clean the outside of the bearing and the bearing bore in the block.

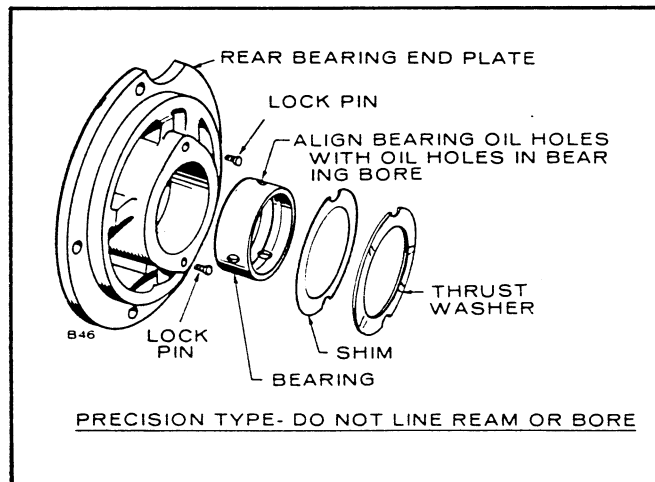


FIGURE 65. BEARINGS FOR REAR BEARING PLATE

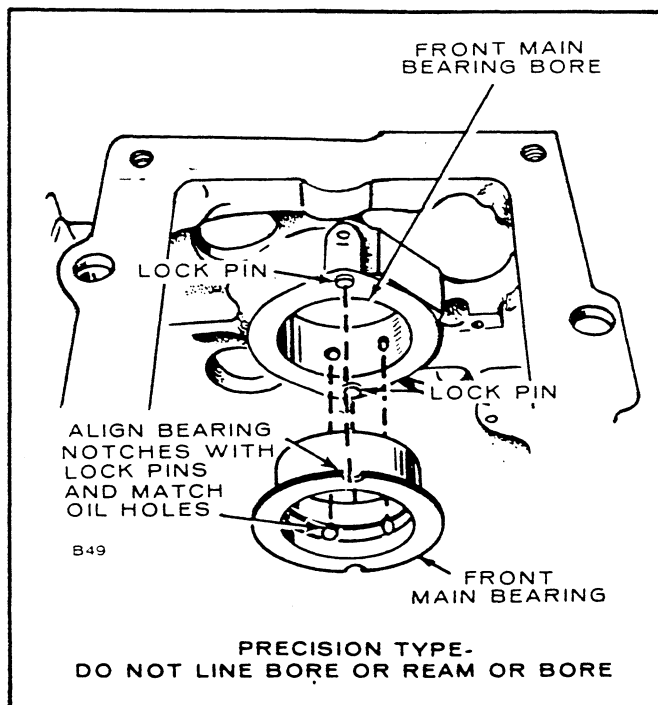


FIGURE 66. FRONT MAIN BEARING INSTALLATION

WARNING

Breathing vapor from towelette and prolonged contact with skin can be harmful. Be sure area is well ventilated.

After allowing three to four minutes for drying, apply the Locktite Bearing Mount from the small tube to the mating surfaces of the bearing and bearing bore. Install the bearing flush with the block using the combination driver just used for the rear bearing. Wipe off any excess Locktite around the bearing. Allow at least one hour for hardening at room temperature.

Lubricate the front main bearing lightly with oil and insert the crankshaft. With the rear bearing plate gasket in place and the rear end plate bearing lubricated, slide the thrust washer (grooves toward crankshaft) and plate over the end of the crankshaft. Line up the notches of the thrust washer with the lock pins before tightening the end plate or the lock pins will be damaged.

NOTE: *A light film of oil on the thrust washer may hold it in place while installing the crankshaft.*

CRANKSHAFT ENDPLAY

After the rear bearing end plate has been tightened using the torque recommended in Assembly Torques and Special Tools, check the crankshaft endplay as shown in Figure 67. If there is too much endplay (see Dimensions and Clearances for minimum and maximum endplay), remove the rear bearing end plate and add a shim (Figure 65) between the thrust washer and plate. Reinstall the end plate making sure the thrust washer and shim notches line up with the lock pins. Torque and recheck endplay of the crankshaft.

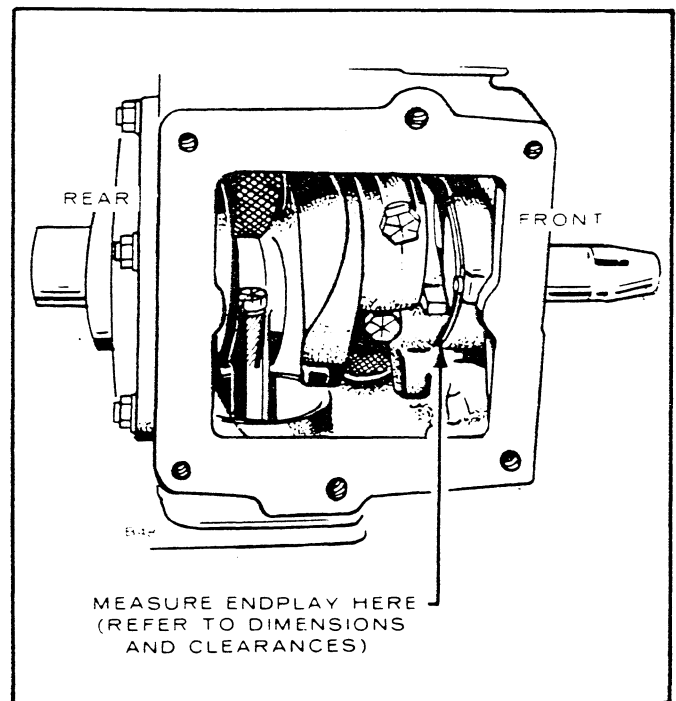


FIGURE 67. CRANKSHAFT ENDPLAY

OIL SEALS

The bearing plate must be removed to replace its oil seal. Drive the oil seal out from the inside using bearing plate driver 420B181 and gear cover driver 420B313.

Before installing the seals, fill the space between seals with a fibrous grease or stiff cup grease. This will improve sealing (See Figure 68).

When installing the gear cover oil seal, tap the seal inward until it is 31/32 of an inch from the mounting face of the cover. Install new style, thin open face seal, 1-7/64 inches from mounting face of cover.

When installing the bearing plate oil seal, tap the seal into the bearing plate bore to bottom against the shoulder in the plate bore. Use a seal expander, or place a piece of shim stock around the end of the crankshaft, when replacing the bearing plate to avoid damaging the seal. Remove the shim stock as soon as the plate is in place.

Engines equipped with some types of reduction gear assemblies, do not use the rear oil seal. The reduction gear assembly is oiled directly from the engine crankcase. Refer to the instructions screened on the case of the reduction gear assembly.

OIL PUMP

To remove the oil pump, it is necessary to detach the intake cup assembly as shown in Figure 69.

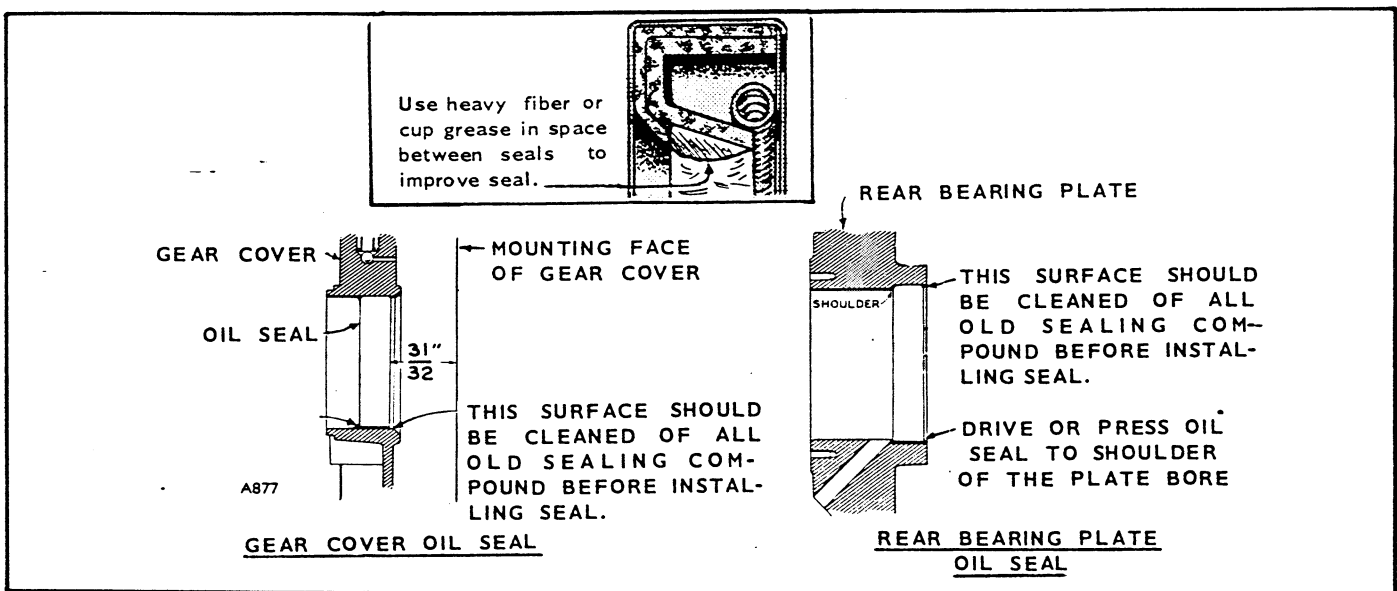


FIGURE 68. GEAR COVER AND REAR BEARING PLATE OIL SEALS

Check the oil pump thoroughly for worn parts. Oil the pump to prime it before reinstalling. Except for gaskets, the component parts of the pump are not available individually. The suction cup is available separately. Install a new pump assembly, if required.

CYLINDER

The cylinder wears very little in normal service. If, through improper lubrication or accident, the cylinder wall should become scored or worn badly, the cylinder may be rebored and honed to accommodate a new piston and ring set of the available oversizes. Pistons are available in .005", .010", .020", .030" and .040" oversize. Piston rings are available in .010", .020", .030" and .040" oversize. Use standard size rings on a .005" oversize piston. If the cylinder is not being reconditioned, but new piston rings are being installed, remove any ridge which may have become formed at the top of piston ring travel in the cylinder bore. Engine might be fitted at the factory with a .005" oversize piston and are so indicated by a letter

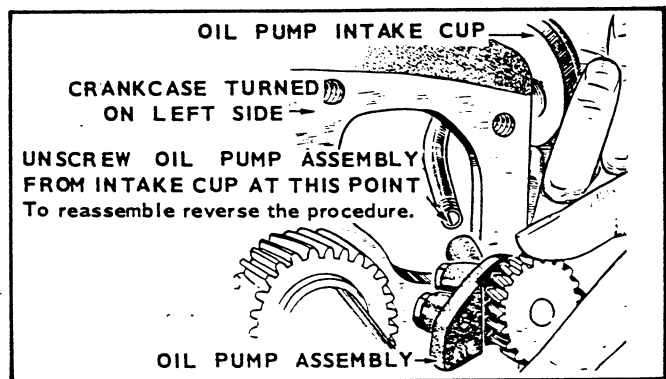


FIGURE 69. OIL PUMP ASSEMBLY

E following the engine serial number stamped on the cylinder block and on the unit nameplate.

The standard cylinder bore size appears in Dimensions and Clearances.

PARTS CATALOG

INSTRUCTIONS FOR ORDERING REPAIR PARTS

For parts or service, contact the dealer from whom you purchased this equipment or refer to your Nearest Authorized Onan Parts and Service Center.

To avoid errors or delay in filling your parts order, please furnish all information requested.

Always refer to the nameplate on your unit:

1. Always give the MODEL and SPEC NO. and SERIAL NO.

The image shows a rectangular nameplate form for Onan equipment. At the top is the Onan logo, which consists of the word "Onan" in a stylized font with a lightning bolt symbol above the 'n'. Below the logo is a horizontal line for "MODEL AND SPEC NO.". Underneath that is another horizontal line for "SERIAL NO.". To the right of the "SERIAL NO." line is a small box. Below these lines is a bold, italicized word "IMPORTANT" followed by the text "ALWAYS GIVE ABOVE NOS. WHEN ORDERING PARTS". Below this is a large rectangular area containing maintenance instructions: "CHECK OIL LEVEL DAILY", "CHANGE OIL EVERY 100 HOURS", "OIL CAPACITY [] QTS", "BELOW 30°F--- SAE 10W", "ABOVE 30°F--- SAE 30", "FOR EXTREME OPERATING TEMPERATURES. SEE YOUR SERVICE MANUAL", and "BATTERY----- [] VOLT". At the bottom of the form, it says "MANUFACTURED BY ONAN", "DIV. OF STUDEBAKER CORPORATION", "MINNEAPOLIS, MINNESOTA, U.S.A.", and "99A66B". The form has four circular mounting holes, one in each corner.

For handy reference, insert YOUR engine nameplate information in the spaces above.

2. Do not order by reference number or group number, always use part number and description.
3. Give the part number, description and quantity needed of each item. If an older part cannot be identified, return the part prepaid to your dealer or nearest AUTHORIZED SERVICE STATION. Print your name and address plainly on the package. Write a letter to the same address stating the reason for returning the part.
4. State definite shipping instructions. Any claim for loss or damage to your unit in transit should be filed promptly against the transportation company making the delivery. Shipments are complete unless the packing list indicates items are back ordered.

Prices are purposely omitted from this Parts Catalog due to the confusion resulting from fluctuating costs, import duties, sales taxes, exchange rates, etc.

For current parts prices, consult your Onan Dealer, Distributor or Parts and Service Center.

“En esta lista de partes los precios se omiten de proposito, ya que bastante confusion resulto de fluctuaciones de los precios, derechos aduanales, impuestos de venta, cambios extranjeros, etc.”

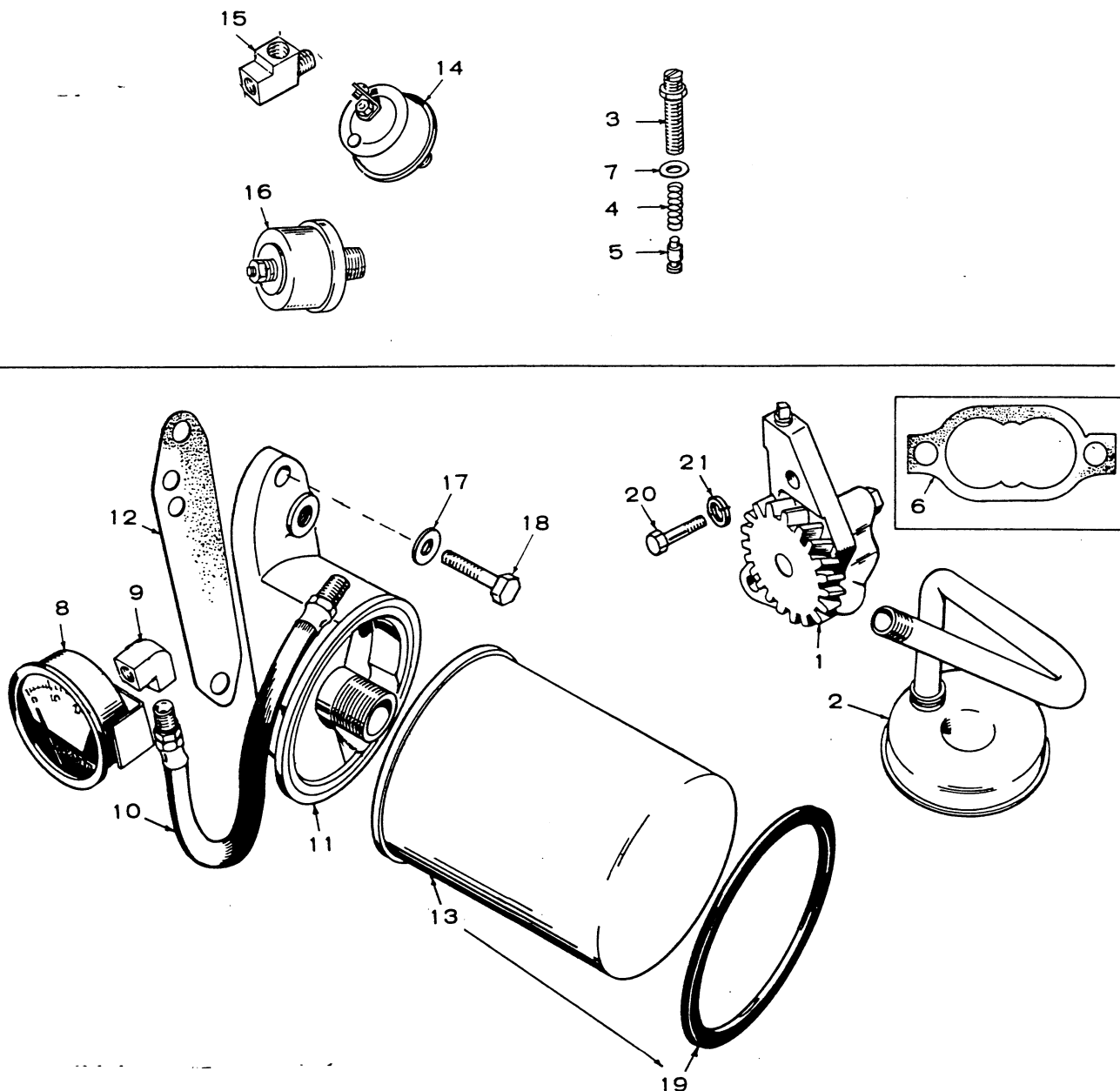
Consiga los precios vigentes de su distribuidor de productos “ONAN”.

This catalog applies to the standard NH Engines as listed below. Parts are arranged in groups of related items. Each illustrated part is identified by a reference number corresponding to the same reference number below the illustration. Parts illustrations are typical. Using the *Model and Spec No.* from the plant nameplate, select the *Parts Key No.* (1, 2, etc., in the last column) that applies to your *Engine Model and Spec No.* This *Parts Key No.* represents parts that differ between models. Unless otherwise mentioned in the description, parts are interchangeable between models. Right and left plant sides are determined by facing the blower end (front) of the engine.

ENGINE DATA TABLE

MODEL AND SPEC NO.	PARTS KEY NO.	MODEL AND SPEC NO.	PARTS KEY NO.
NH-S/*	1	NH-MS/*	2

* The Specification Letter Advances (A to B, B to C, etc.) with manufacturing changes.

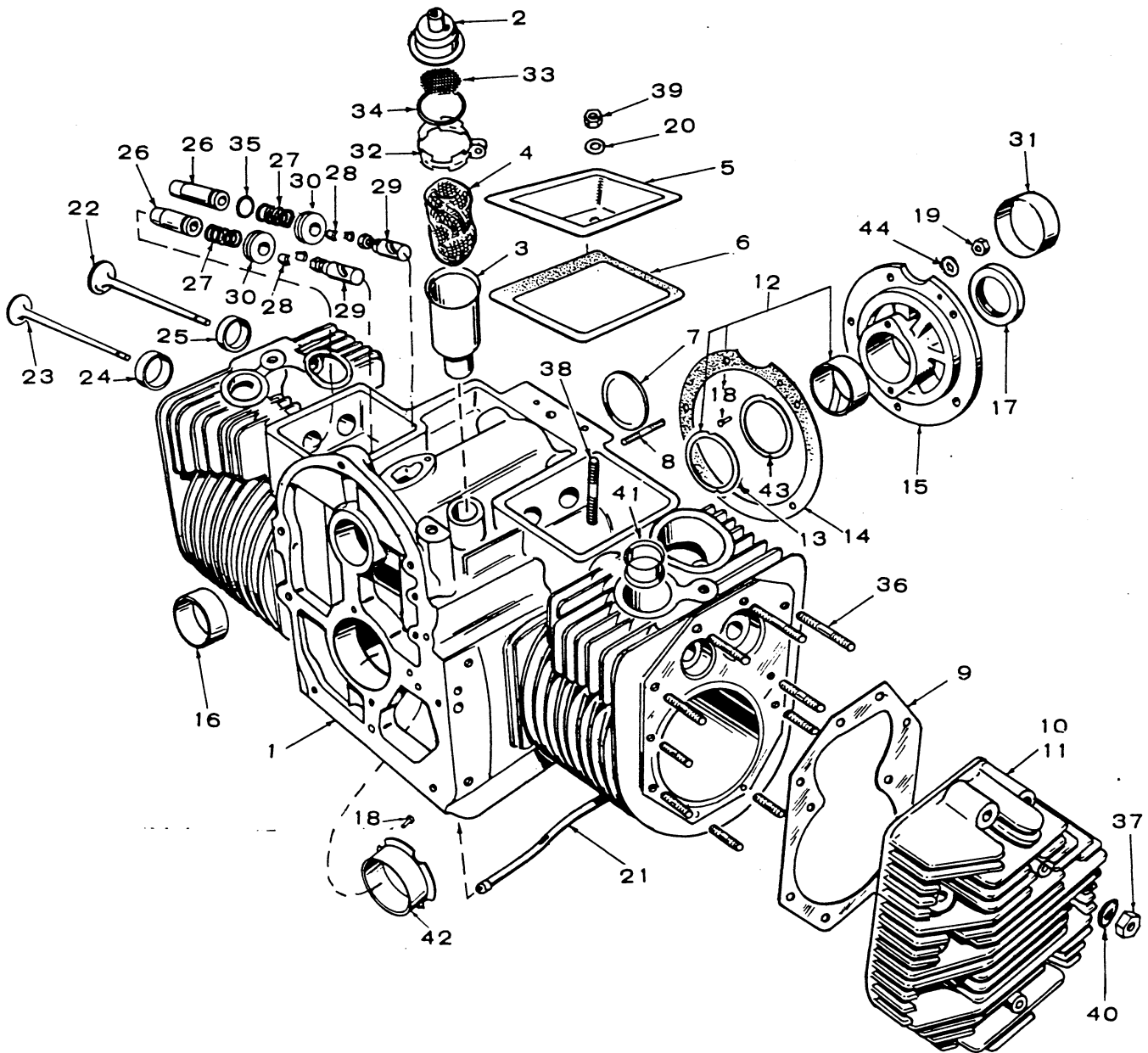


OIL SYSTEM GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	120A491	1	Pump, Oil (Components Not Sold Separately)
2	*	1	Intake, Oil Pump - Includes Cup, Screen & Pipe
3	120A187	1	Stud Assembly, By-Pass Adjusting (Includes Nut)
4	120A140	1	Spring, By-Pass Valve
5	120A398	1	Valve, By-Pass
6	120K161	1	Gasket Kit, Oil Pump
7	526-66	1	Washer, Oil Pressure Relief Valve Adjusting Screw
8	193P5	1	Gauge, Oil Pressure
9	502-5	1	Elbow, Oil Line to Gauge
10	501-3	1	Line, Flexible - Oil Gauge
11	122D320	1	Adapter, Oil Filter

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
12	122A321	1	Gasket, Adapter
13	122B323	1	Filter, Oil
14	309A10	1	Switch, Low Oil Pressure - Opt.
15	502-58	1	Tee, Low Oil Pressure Switch - Optional
16	193-108	1	Sender, Oil Pressure - Optional
17	526-65	2	Washer (Copper), Adapter Mtg.
18	800-28	2	Screw, Hex Cap - Adapter Mtg.
19	122A347	1	Gasket, Oil Filter
20	800-7	2	Screw (1/4-20 x 1") - Oil Pump Mounting
21	850-40	2	Washer, Lock (1/4")

* - Order by description, giving complete Model, Spec and Serial Number.



CYLINDER BLOCK GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	★	1	Block Assembly, Cylinder (Includes Parts Marked *)
2	123A954	1	Cap & Valve, Breather
3	123A952	1	Tube, Breather
4	123P865	1	Baffle, Breather Tube
5	110A1624	2	Cover, Valve Compartment
6	110B1720	2	Gasket, Valve Cover
7	517-48	1	Plug, Camshaft Expansion
8	520A736	5	Stud, Rear Bearing Plate Mtg.
9	110C1731	2	Gasket, Cylinder Head
10	HEAD, CYLINDER (#2) - RH		
	110D1732	1	Spec A and B
	110B1905	1	Begin Spec C
11	HEAD, CYLINDER (#1) - LH		
	110D1733	1	Spec A and B
	110B1906	1	Begin Spec C
12	*BEARING, CRANKSHAFT - REAR		
	101K420	1	Standard
	101K420-02	1	.002" Undersize
	101K420-10	1	.010" Undersize
	101K420-20	1	.020" Undersize
	101K420-30	1	.030" Undersize
13	104A575	2	*▲Washer, Thrust - Crankshaft Bearing
14	101B415	1	Gasket, Bearing Plate
15	*PLATE, REAR BEARING (Excludes Bearing - Includes Pins)		
	101C407	1	Engines Without Reduction Gear Assembly
	101B417	1	Engine With Reduction Gear Assembly
16	101B405	2	*Bearing, Camshaft Front & Rear (Precision)
17	509A41	1	Seal, Bearing Plate
18	516A72	4	*Pin, Main Bearing Stop
19	104-91	5	Nut, Bearing Plate Stud
20	526-63	2	Washer (Copper), Valve Compartment Cover
21	120B680	1	*Tube, Crankcase Oil
22	110B1756	2	Valve, Intake (Stellite)
23	110B1719	2	Valve, Exhaust (Stellite)
24	*INSERT, EXHAUST VALVE SEAT (STELLITE)		
	110A1716	2	Standard
	110A1716-02	2	.002" Oversize
	110A1716-05	2	.005" Oversize
	110A1716-10	2	.010" Oversize
	110A1716-25	2	.025" Oversize

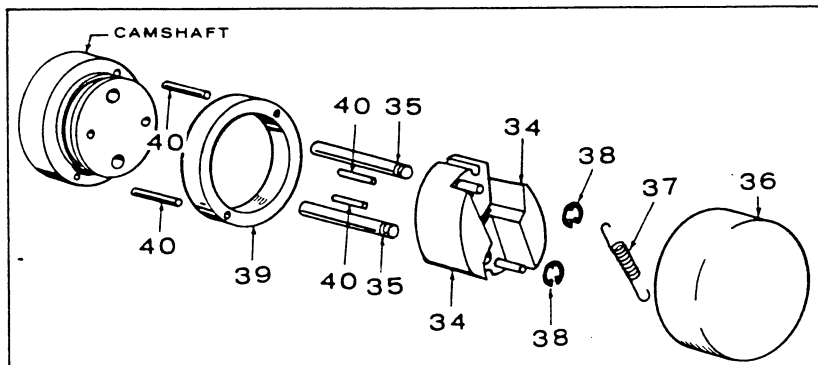
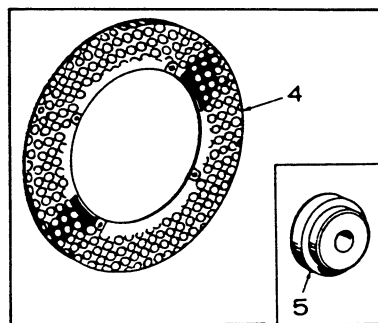
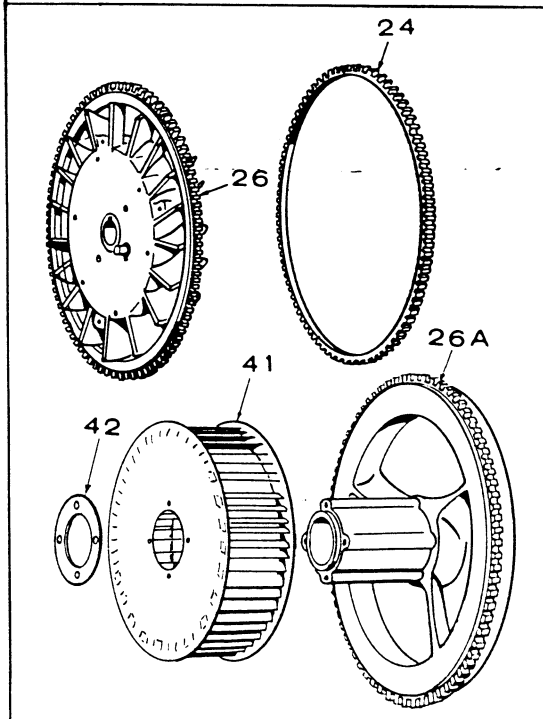
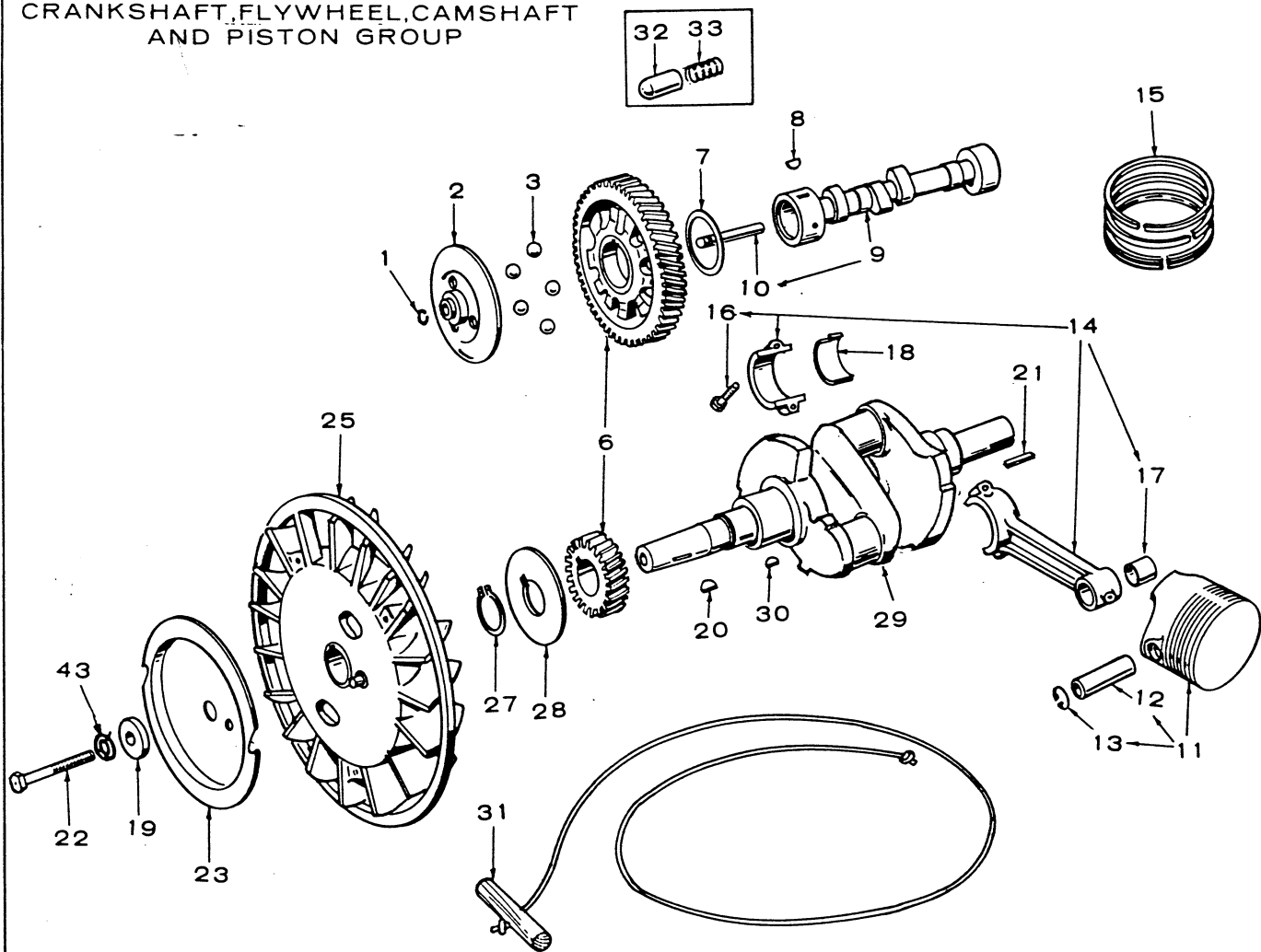
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
25	*INSERT, INTAKE VALVE SEAT (STELLITE)		
	110B1932	2	Standard
	110B1932-02	2	.002" Oversize
	110B1932-05	2	.005" Oversize
	110B1932-10	2	.010" Oversize
	110B1932-25	2	.025" Oversize
26	110A1939	4	*Guide, Valve
27	110A539	4	Spring, Valve
28	110A639	8	Lock, Valve & Spring, Retaining
29	TAPPET, VALVE		
	115A6	4	Standard
	115A6-05	4	.005" Oversize
30	110A904	4	Rotocap
31	110A1283	1	Cover, Timing Control (Also in Camshaft Group)
32	123A951	1	Clamp, Breather Tube Cap
33	123A958	1	Screen, Breather Tube
34	509-117	1	Seal, "O" Ring, Breather Tube
35	110A68	2	*Gasket, Valve Guide (Intake)
36	STUD, CYLINDER HEAD MOUNTING		
	520A717	8	3/8" x 2"
	520A715	8	3/8" x 2-1/4"
	520A716	4	3/8" x 2-5/8"
37	NUT, FLANGE - CYLINDER HEAD STUD		
	870-248	20	Spec A and B
	104A91	20	Begin Spec C
38	520A714	2	Stud, Valve Box Cover
39	115A25	2	Nut, Hex - Valve Box Cover Stud
40	526A250	20	Washer, Flat - Cylinder Head Stud - Begin Spec C
41	154A1424	2	Insert, Exhaust Port - Begin Spec C
42	*BEARING, CRANKSHAFT - FRONT		
	101K432	1	Standard
	101K432-02	1	.002" Undersize
	101K432-10	1	.010" Undersize
	101K432-20	1	.020" Undersize
	101K432-30	1	.030" Undersize
43	104A776	As Req.	Shim (.005") - Crankshaft Thrust
44	526-251	5	Washer, Flat - Bearing Plate Stud
	800-46	2	Screw, Hex Head Cap (3/8-16 1/2) - Cylinder Block
	526-66	2	Washer (3/8 Copper) - Cylinder Block

★ - Order by description, giving complete Model, Spec and Serial Number.

* - Included in Cylinder Block Assembly.

▲ - Use one only with rear bearing on units with flange type front bearing.

CRANKSHAFT, FLYWHEEL, CAMSHAFT AND PISTON GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	150A78	1	*Ring, Snap - Camshaft Center Pin
2	150B612	1	*Cup, Governor
3	510-15	5	*Ball, Fly - Governor
4	134B1889	1	Guard, Blower Wheel - Optional
5	ADAPTER, FRONT POWER TAKE OFF - KEY 2 - OPT.		
	104A700	1	Spec A Only
	104A732	1	Begin Spec B
6	105A353	1	Gear Set, Timing - Inc. 1 each Crankshaft & Camshaft Gears (Incl. Flyball Spacer & Plate)
7	105A4	1	Washer, Camshaft Gear Thrust
8	515-1	1	Key, Camshaft Gear Mounting
9	CAMSHAFT		
	105B309	1	*Governor Controlled Engine (Includes Center Pin)
	105B317	1	*Governor Controlled Engine (Includes Center Pin & Spark Advance Mechanism Pins)
	105C310	1	Manually Controlled Engine
	105B321	1	*Manually Controlled Engine (Includes Spark Advance Mechanism Pins)
10	150A75	1	*Pin, Center - Camshaft
11	PISTON AND PIN (INCLUDES RETAINING RINGS)		
	112-111	2	Standard
	112-111-05	2	.005" Oversize
	112-111-10	2	.010" Oversize
	112-111-20	2	.020" Oversize
	112-111-30	2	.030" Oversize
	112-111-40	2	.040" Oversize
12	PIN, PISTON		
	112A112	2	Standard
	112A112-02	2	.002" Oversize
13	518P294	4	Ring, Piston Pin Retaining
14	114C203	2	Rod, Connecting (Includes Bushing & Bolts)
15	RING SET, PISTON		
	113A165	2	Standard
	113A165-05	2	.005" Oversize
	113A165-10	2	.010" Oversize
	113A165-20	2	.020" Oversize
	113A165-30	2	.030" Oversize
	113A165-40	2	.040" Oversize
16	805A10	4	Bolt, Place - Connecting Rod Cap
17	114A36	2	Bushing, Piston Pin - Connecting Rod
18	BEARING HALF, CONNECTING ROD		
	114B188	4	Standard
	114B188-02	4	.002" Undersize
	114B188-10	4	.010" Undersize
	114B188-20	4	.020" Undersize
	114B188-30	4	.030" Undersize

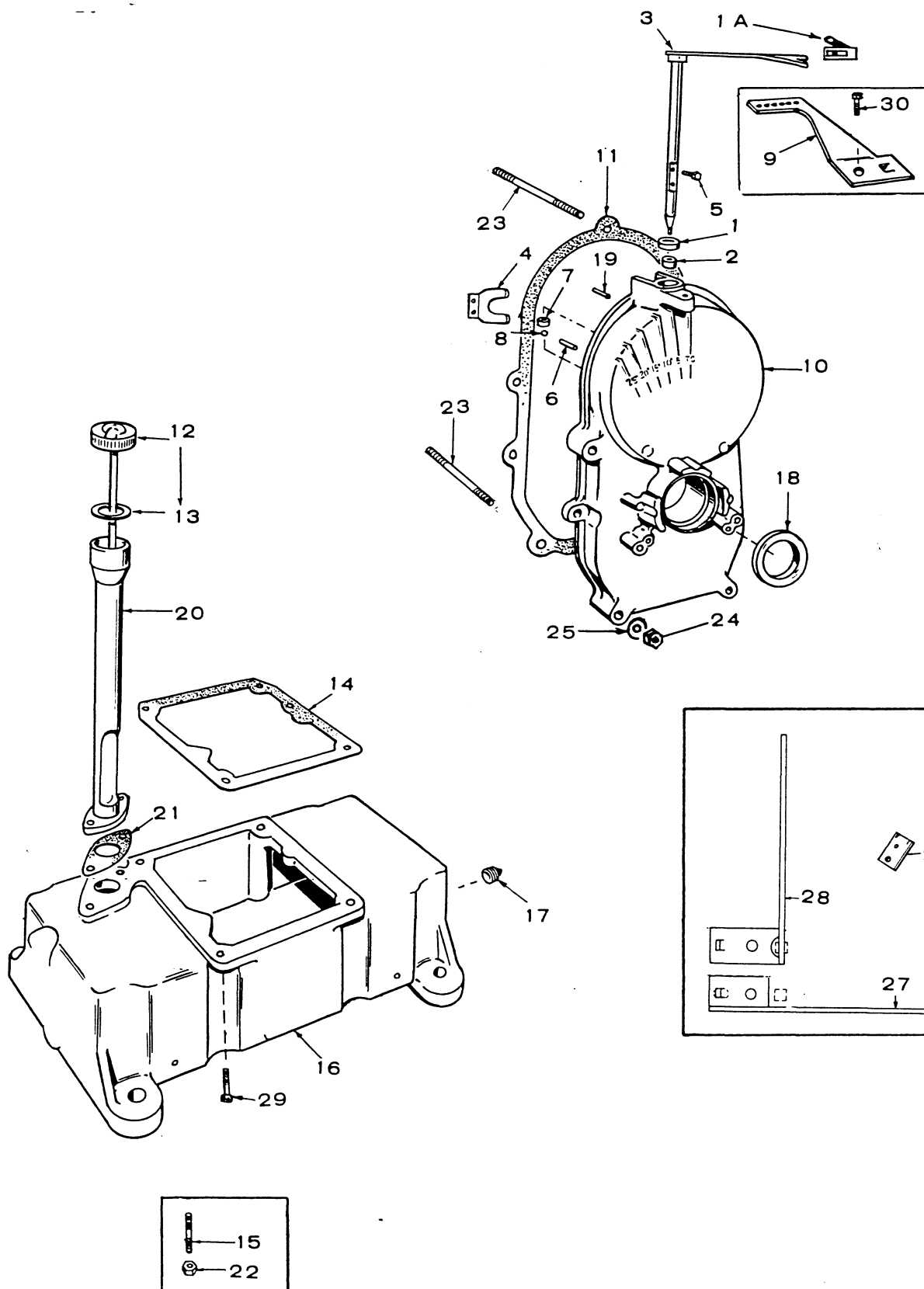
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
19	WASHER, WHEEL MOUNTING		
	526A17	1	Key 1 and Vacu-Flo Cooled Engines
	526A128	1	Key 2
20	515-2	1	Key, Wheel Mounting
21	515A198	1	Key, Crankshaft Stub
22	104A170	1	Screw, Wheel Mounting
23	192B308	1	Sheave, Starter Rope - Key 1
24	134C673	1	Gear, Ring - Flywheel, Key 2 & Vacu-Flo Cooled Engines
	FLYWHEEL		
25	160E1080	1	Key 1
26	134B2071	1	Key 2 (Includes Ring Gear) - Spec A Only
26	134B1895	1	Key 2 (Includes Ring Gear) - Begin Spec B
26A	104B740	1	Vacu-Flo Cooled Engines (Includes Ring Gear)
27	518-14	1	Lock, Crankshaft Gear Washer
28	104A43	1	Washer, Crankshaft Gear Ret.
29	**	1	Crankshaft
30	515-1	1	Key, Crankshaft Gear Mtg.
31	192A83	1	Rope, Manual Starting - Key 1
32	105A58	1	Plunger, Camshaft, Thrust (Manually Controlled Engine)
33	105A59	1	Spring, Camshaft Plunger (Manually Controlled Engine)
34	*WEIGHT ASSEMBLY, TIMING CONTROL - INCLUDES PINS		
	160A1049	2	Magneto Ignition
	**	2	Battery Ignition
35	516P172	2	*Pin, Groove (1-1/16") Timing Control
36	110A1283	1	*Cover, Timing Control (Also in Cylinder Block Group)
37	160A1051	1	*Spring, Timing Control
38	518P129	2	*Ring, Timing Control Retainer
39	160A791	1	*Cam, Timing Control
40	516-144	5	*Pin, Roll (7/16") Camshaft & Timing Control Cam
41	134C2130	1	Wheel, Blower - Vacu-Flo Cooled Engines
42	134A911	1	Plate, Blower Wheel - Vacu-Flo Cooled Engines
43	850-55	1	Washer, Lock (7/16")

★ Standard for Key 1, Optional for Key 2.

* For governor controlled engine only.

** Give Engine Model, Spec and Serial Number.

GEAR COVER AND OIL BASE GROUP



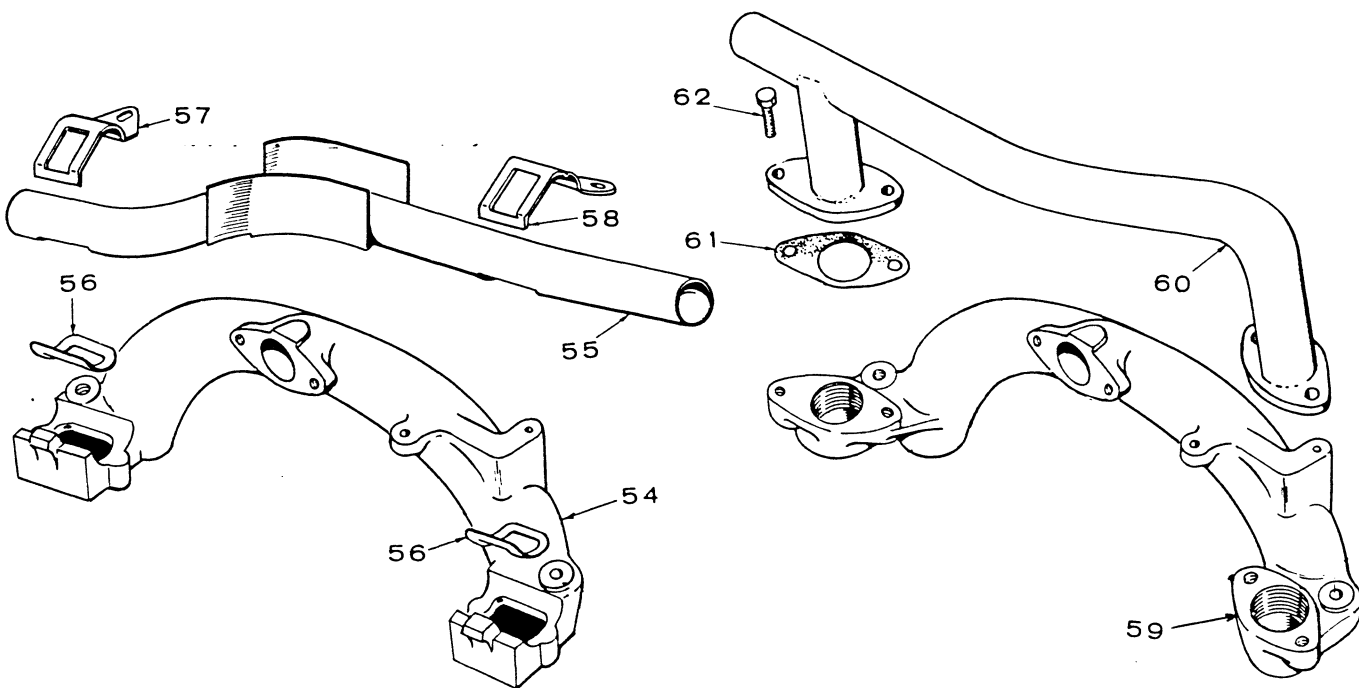
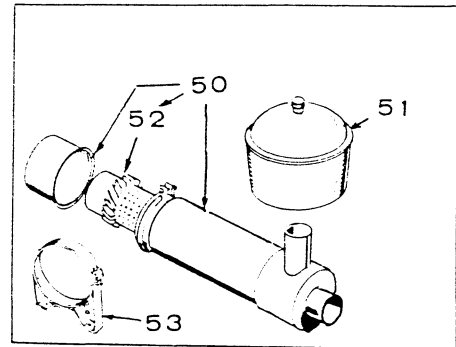
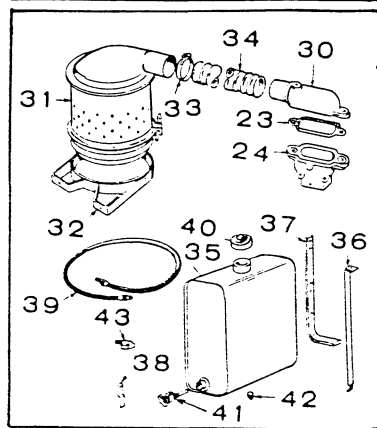
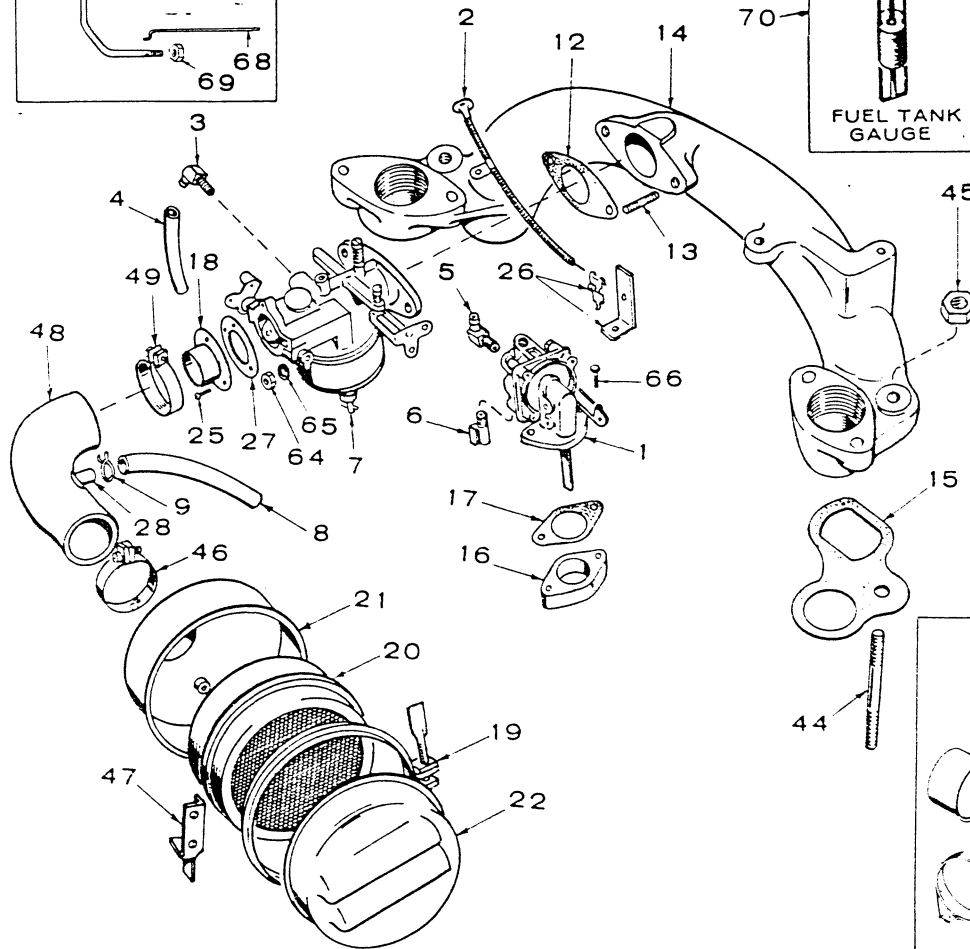
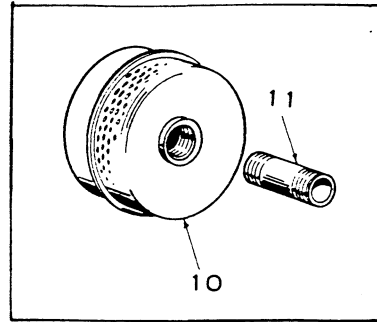
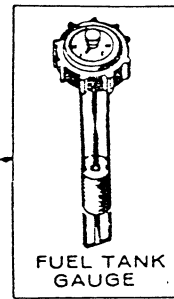
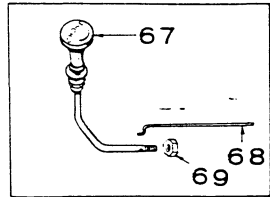
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	509P8	1	*Seal, Oil - Governor Shaft
1A	150A678	1	Clip, Governor Sensitivity Adjustment (Standard Speed Governor) Key 2
2	510P13	1	*Bearing, Governor Shaft (Upper)
3	150B1260	1	*Shaft & Arm, Governor
4	150B1187	1	*Yoke, Governor Shaft
5	819-46	2	*Screw, Yoke Mounting (8-32 x 3/8 ")
6	516-130	1	*Pin, Governor Cup Stop (In Gear Cover)
7	510A8	1	*Bearing, Governor Shaft (Lower)
8	510P14	1	*Ball, Bearing, Governor Shaft
9	150B1073	1	Extension, Governor Arm
10	COVER ASSEMBLY, GEAR 103A386	1	Standard Governor (Also for Flywheel Alternator Models) - Includes Parts Marked * - Key 1 (and Key 2 Begin Spec B)
	103B334	1	Standard Governor (Also for Flywheel Alternator Models) - Includes Parts Marked * - Key 2 - Spec A Only
	103A387	1	Manual Throttle - Includes Oil Seal (Also for Flywheel Alternator Models) - Key 1 (and Key 2 Begin Spec B)
	103A352	1	Manual Throttle - Includes Oil Seal (Also for Flywheel Alternator Models) - Key 2 - Spec A Only
11	103B11	1	Gasket, Gear Cover
12	†	1	Cap & Indicator, Oil Fill
13	123A191	1	Gasket, Oil Fill Cap

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
14	102B646	1	Gasket, Oil Base Mounting
15		4	Stud, Oil Base to Block - Early Models (Order #800-51 Cap Screw)
16	†	1	Base, Oil
17	505-56	1	Plug, Oil Drain
18	*SEAL, GEAR COVER		
	509A40	1	Key 1 (and Key 2 Begin Spec B)
	509A97	1	Key 2 - Spec A Only
19	516A11	2	Pin, Gear Cover (5/16 x 1-1/8 ")
20	123B1117	1	Tube, Oil Fill
21	141A78	1	Gasket, Oil Fill Tube Mounting
22	104A91	4	Nut, Hex - Oil Base Stud - Early Models
23	STUD, GEAR COVER TO BLOCK		
	520A710	4	5/16 x 2-1/8 "
	520A711	1	5/16 x 3-11/16 "
24	110A445	5	Nut, Gear Cover Mounting Stud
25	526-65	5	Washer (Copper), Gear Cover Mounting
	ARM, GOVERNOR PULL - CONSTANT SPEED GOVERNOR - OPTIONAL		
26	150A1268	1	Rear Pull
27	150A755	1	Front Pull
28	150A752	1	Right Pull
29	800-51	4	Screw (3/8-16 x 1-1/4 ") - Oil Base to Block
30	815-181	1	Screw, Governor Arm Extension Mounting

* Included in Gear Cover Assembly.

† Order by description, giving complete Model, Spec and
Serial Number.

FUEL SYSTEM GROUP



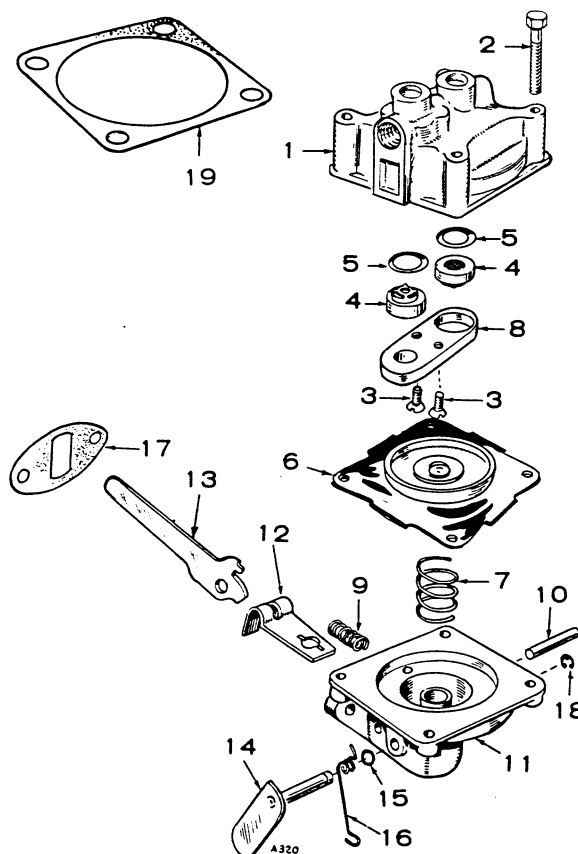
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	149K526	1	Repair Kit, Fuel Pump
1	149D1223	1	Pump, Fuel
2	149A1024	1	Rod, Fuel Pump Primer, Key 1
3	502-313	1	Elbow, Carburetor Inlet
4	149A1228	1	Line, Fuel Pump to Carburetor
5	502-313	1	Elbow, Fuel Pump Outlet
6	502-2	1	Elbow, Fuel Pump Inlet
7	CARBURETOR, GASOLINE (Separate Group for Components)		
	141D689	1	Manual Choke
	141D690	1	Electric Choke
8	503A582	1	Hose, Breather
9	503-170	2	Clamp, Breather Hose
10	155B1092	2	Muffler, Exhaust
11	505-263	2	Nipple, Exhaust (1-1/4 x 6'')
12	141A281	1	Gasket, Carburetor Mounting
13	520A526	2	Stud, Carburetor Mounting
14	154C1286	1	Manifold, Intake
15	154A1250	2	Gasket, Intake Manifold to Cylinder Block
16	149A45	1	Spacer, Fuel Pump Mounting
17	149A3	2	Gasket, Fuel Pump Mounting
18	145A398	1	Adapter, Carburetor Air Inlet
19	140B1073	1	Clamp, Air Cleaner
20	140B1071	1	Element, Air Cleaner
21	140C1066	1	Cleaner, Air
22	140C1061	1	Cover, Air Cleaner
23	140A584	1	Gasket, Air Cleaner - Optional
24	140A936	1	Adapter, Air Cleaner - Optional
25	815-199	3	Screw (10-32 x 5/16'') - Adapter Mounting
26	153-263	1	Bracket & Clamp, Manual Choke - Optional
27	140A921	1	Gasket, Adapter to Carburetor
28	123A733	1	Tube, Elbow to Breather Hose
30	140C645	1	Adapter, Air Cleaner - Optional
31	140B500	1	Cleaner, Air (Oil Bath) - Optional
32	140B519	1	Band, Air Cleaner - Optional
33	503P365	2	Clamp, Air Cleaner Hose - Opt.
34	503A444	1	Hose, Air Cleaner - Optional
35	159B575	1	Tank, Fuel - Optional
36	159A596	2	Strap, Fuel Tank - Optional
37	159B595	2	Bracket, Fuel Tank - Optional
38	134A599	1	Clip, Fuel Line - Optional
39	501A8	1	Line, Fuel - Optional (Use With Opt. Side Mounted Fuel Tank)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
40	159A7	1	Cap, Fuel Tank - Optional
41	504A13	1	Valve, Shut-off - Optional
42	505-57	1	Plug, Fuel Tank Drain - Optional
43	502-20	1	Elbow, Fuel Pump to Fuel Line (Use with Optional Side Mounted Fuel Tank)
44	520A713	2	Stud, Intake Manifold Mounting
45	104A91	2	Nut, Intake Manifold Stud
46	503-311	1	Clamp, Hose - Air Cleaner
47	140B1067	1	Bracket, Air Cleaner Mounting
48	140A1075	1	Elbow, Carburetor Air Inlet
49	503-4	1	Clamp, Hose - Air Inlet Elbow to Adapter
50	140P721	1	Cleaner, Air - Optional
51	140P723	1	Pre-Cleaner (Plastic) - Air Cleaner - Optional
52	140P765	1	Element Only, Air Cleaner - Optional
53	140P722	1	Band, Air Cleaner Mounting - Optional
54	154C1238	1	Manifold, Intake - Crossover Exhaust (Low Profile) - Opt.
55	155B1069	1	Tube, Exhaust - Crossover Exhaust - Optional
56	155A1070	2	Gasket, Exhaust Tube - Opt.
57	155B1052	1	Clamp, Exhaust Tube, L.H. - Optional
58	155B1053	1	Clamp, Exhaust Tube, R.H. - Optional
59	154C1384	1	Manifold, Intake - Crossover Exhaust (High Profile) - Opt.
60	MANIFOLD, EXHAUST (HIGH PROFILE) - OPTIONAL		
	154C1386	1	L.H. Outlet
	154C1382	1	R.H. Outlet
61	154A1383	2	Gasket, Exhaust Manifold - Opt.
62	821-16	4	Screw, Locking (5/16-18 x 3/4'') - Exhaust Manifold Mounting
64	868-2	2	Nut, Hex (Jam) - Carburetor Mtg.
65	854-17	2	Washer, Lock - Carburetor Mtg.
66	806-9	2	Screw (1/4-20 x 1-1/4'') - Fuel Pump Mounting
67	153C439	1	Lever, Choke - Engines With Top Mounted Control - Optional
68	153A442	1	Linkage, Choke - Engines With Top Mounted Control - Optional
69	870-53	1	Nut (10-32) - Choke Lever
70	193P207	1	Cap and Gauge Assembly - Optional

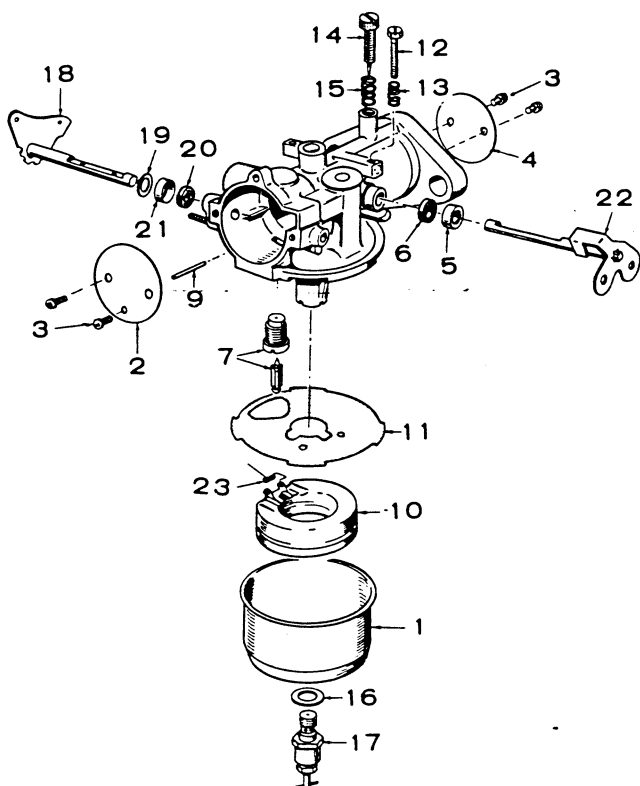
FUEL PUMP PARTS GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	149D1223	1	Pump, Fuel (Illustrated in Fuel System Group)
	149K526	1	Repair Parts Kit - Includes Parts Marked *
1		1	Body, Not Sold Separately
2	815-148	4	Screw, Machine, #8-32 x 7/8"
3	815-147	2	Screw, Phillips Self Tapping, #6-32 x 5/8", Valve Retainer
4	149-96	2	*Valve and Cage
5	149A95	2	*Gasket, Valve
6	149A582	1	*Diaphragm Assembly
7	149A672	1	*Spring
8	149A539	1	Retainer, Valve Cage
9	149A675	1	*Spring
10	516A113	1	Pin, Rocker Arm
11		1	Body, Not Sold Separately
12	149A670	1	Link, Rocker
13	149B1148	1	Arm, Rocker
14	149A1042	1	Lever, Primer
15	509-65	2	Seal, "O" Ring
16	149A1044	1	Spring, Primer Lever
17	149A3	1	*Gasket, Pump Mounting
18	518P129	1	Ring, Retainer, Primer Lever
19	149A858	1	*Gasket, Diaphragm-Lower Side

* Parts in Repair Kit



CARBURETOR PARTS GROUP

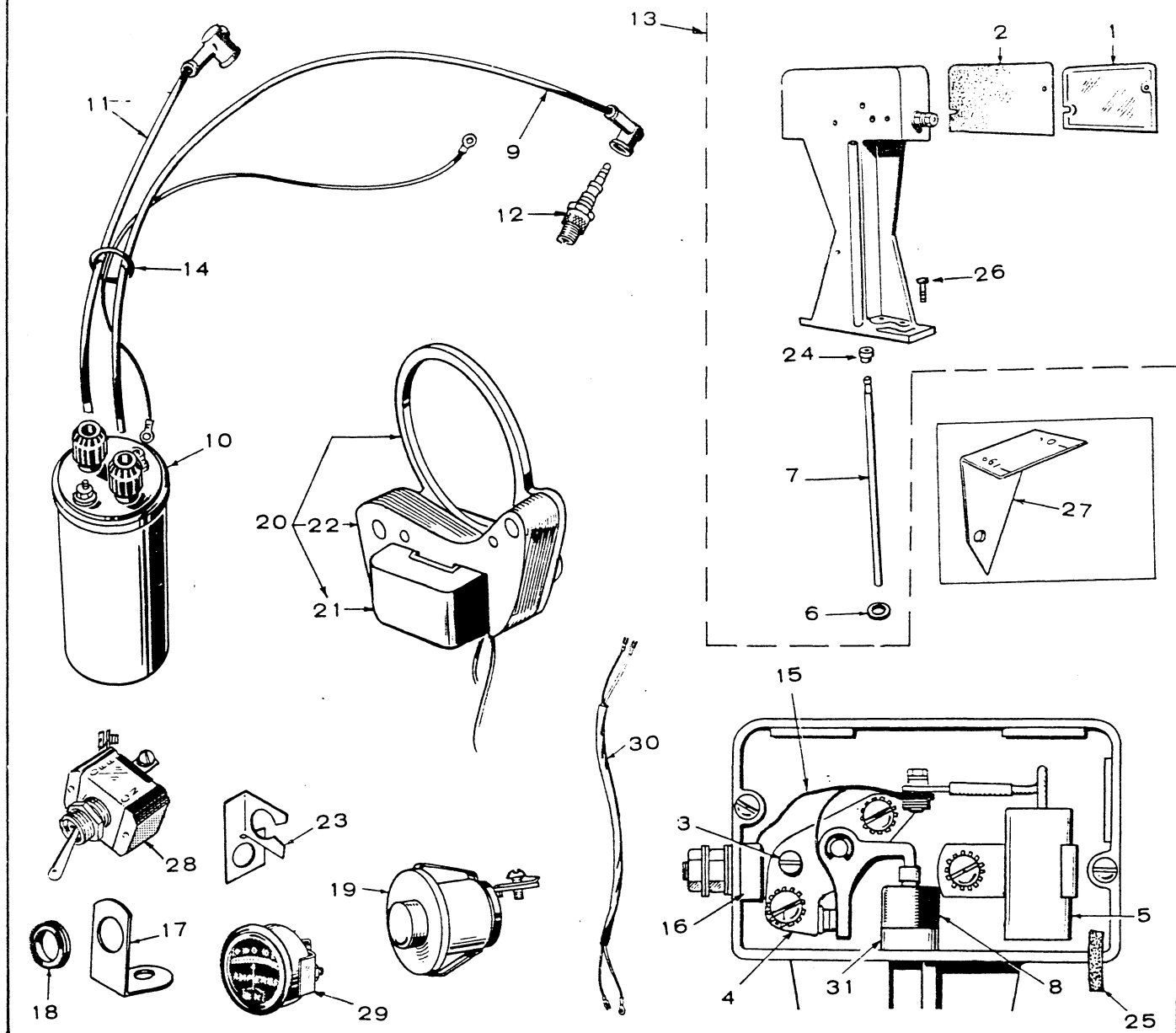


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
CARBURETOR, GASOLINE			
	141D689	1	Manual Choke
	141D690	1	Electric Choke
	141P747	1	Repair Kit (Includes Parts Marked *)
	141K748	1	Gasket Kit (Includes Parts Marked *)
	141A281	1	*★Gasket, Carburetor Flange
1	141P708	1	Bowl, Fuel
2	141P741	1	Plate, Choke
3	141P698	4	Screw & Washer, Choke & Throttle Plate Mounting
4	141P706	1	Plate, Throttle
5	141P705	1	*Retainer, Seal
6	141-661	1	*★Seal, Rubber
7	141P798	1	*Valve Seat Assembly, Fuel
9	141P703	1	*Shaft, Float
10	141P702	1	Float Assembly
11	141P701	1	*★Gasket, Bowl to Body
12	141P700	1	Screw, Throttle Stop
13	141P711	1	Spring, Throttle Stop
14	141P713	1	Needle, Idle Adjusting
15	141P710	1	Spring, Idle Needle
16	141A77	1	*★Washer, Main Jet Assembly
17	141P712	1	Jet Assembly, Main (Adjustable)
18	SHAFT, CHOKE		
	141-742	1	Manual Choke Units
	141B679	1	Electric Choke Units
19	141P699	1	Washer, Manual Choke Units
20	141P697	1	*★Seal, Felt - Manual Choke Units
21	141P203	1	*Retainer, Felt Seal - Manual Choke Units
22	141P709	1	Shaft & Lever, Throttle
23	141-799	1	*Spring, Float

* Parts contained in Repair Kit.

*★Parts contained in Gasket Kit.

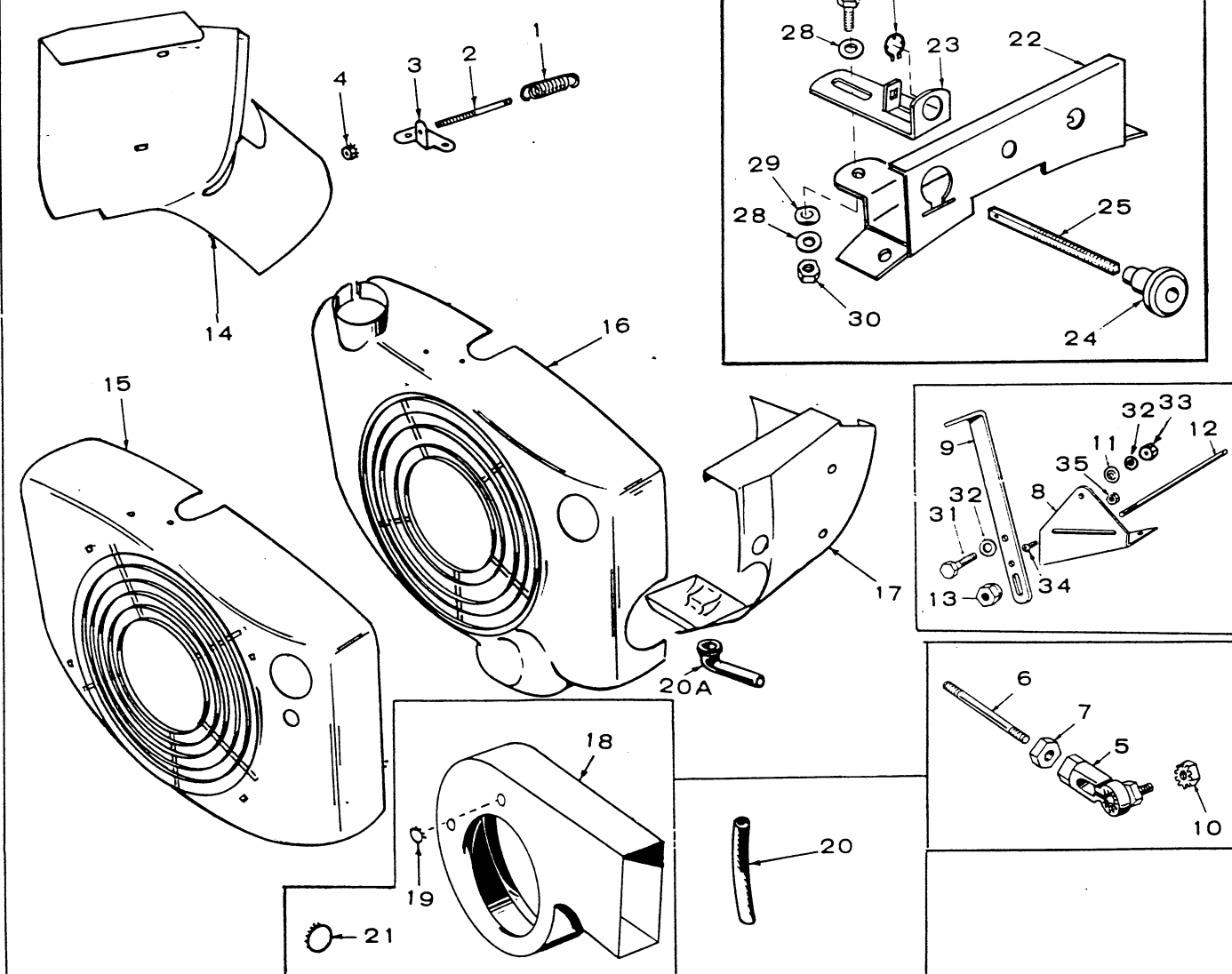
IGNITION GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	160A930	1	Cover, Breaker Box
2	160A150	1	Gasket, Breaker Box Cover
3	160A75	1	Cam, Point Gap Adjusting
4	160A2	1	Point Set, Breaker
5	312A69	1	Condenser, Breaker Points
6	160A1040	1	Gasket, Breaker Box Mounting
7	160A723	1	Plunger
8	160A1143	1	Diaphragm, Breaker Box
9	CABLE, SPARK PLUG - RIGHT HAND		
	167A1464	1	Key 2 (24")
	167A1548	1	Key 1 (21")
10	166B535	1	Coil, Ignition, Key 2
11	167A1463	1	Cable (19"), Spark Plug - L.H.
12	167-241	2	Plug, Spark
13	160A1135	1	Box, Breaker (Includes Points, Condenser Cover, Gasket & Bushing)
14	509-35	1	"O" Ring - Spark Plug Cables
15	160A428	1	Strap, Point Set to Terminal Block
16	160A349	1	Block & Terminal Assembly

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
17	332A273	1	Clip, Magneto Lead, Key 1
18	GROMMET	1	Magneto Lead Clip, Key 1
	508A2	1	Ignition Coil Lead, Key 2
	508P114	1	Spark Plug Cables
	508P95	2	Spark Plug Cables
19	313-18	1	Switch, Ignition Stop, Key 1
20	160B1121	1	Magneto Stator Assy., Key 1
21	160D1124	1	Coil, Magneto Stator, Key 1
22	160B1118	1	Pole Shoe, Magneto Stator, Key 1
23	167A188	4	Clip, Spark Plug Cables, Key 1
24	160A1041	1	Bushing, Breaker Box (Bottom)
25	160A261	1	Wick, Breaker Box
26	815P357	2	Screw, Mounting - Breaker Box
27	166B519	1	Bracket, Timing - Vacu-Flo Cooled Engines
28	308A140	1	Switch, Toggle - Ignition (Start-On-Off) - Optional
29	302A60	1	Ammeter, DC (20-0-20) - Opt.
30	338A613	1	Harness, Wiring - Ammeter to Terminal Block - Optional
31	160A931	1	Guide, Plunger

HOUSING AND GOVERNOR GROUP



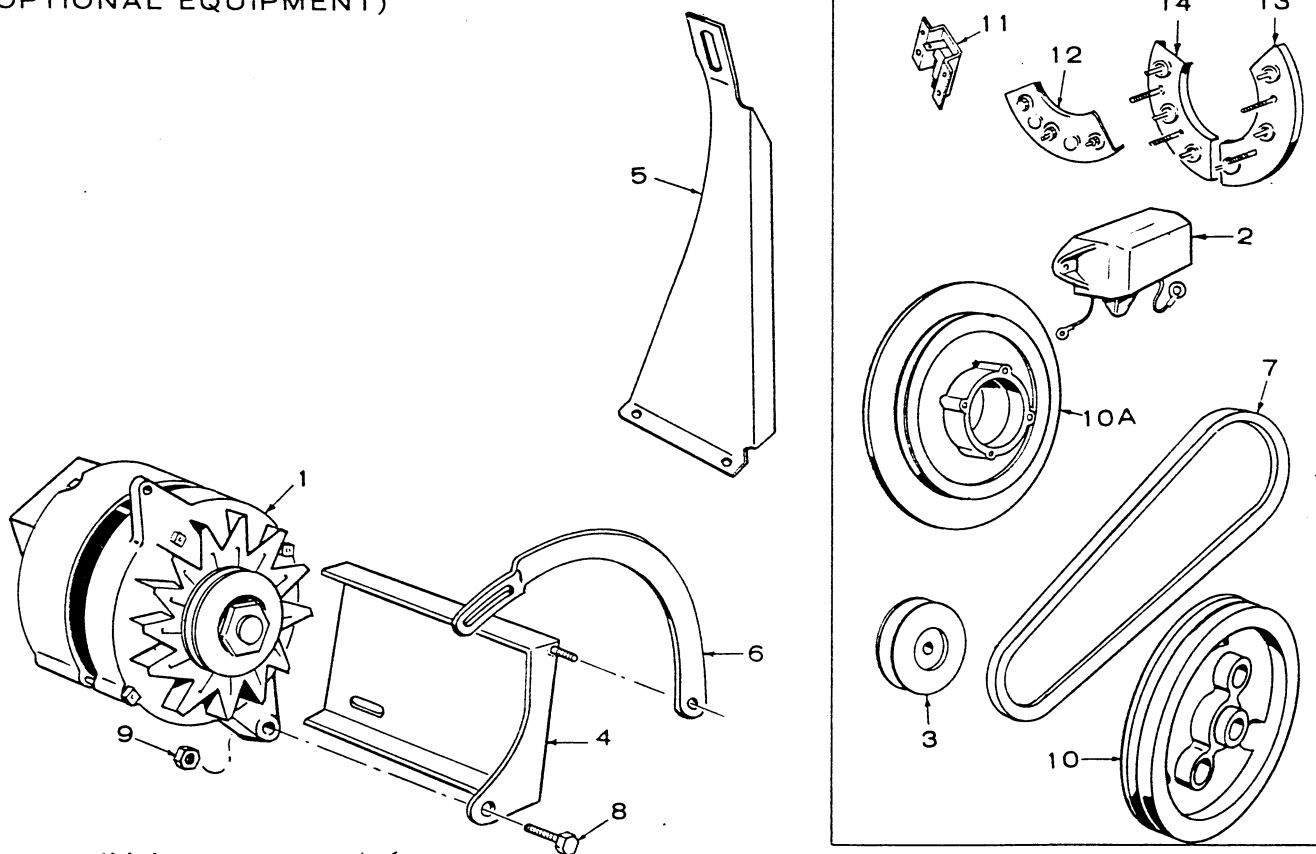
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	150A98	1	Spring, Governor (All Governor Controlled Engines)
2	150A96	1	Stud, Speed Adjustment (Std. Governor Controlled Engine)
3	150A1262	1	Bracket, Speed Stud (Standard Governor Controlled Engine)
4	870-131	1	Nut, Speed Adjustment (Std. Governor Controlled Engine)
5	150A939	2	Joint, Ball (All Governor Controlled Engines)
6	520A623	1	Link, Throttle (All Governor Controlled Engines)
7	870P188	2	Palnut, Locking
8	152B86	1	Bracket, Variable Speed Control (Optional)
9	152A83	1	Lever, Variable Speed Control (Optional)
10	870-131	2	Nut, Keys
11	152A41	1	Washer, Variable Speed Lever Tension (Optional)
12	152A90	1	Stud, Variable Speed Adjustment (Optional)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
13	150A621	1	Nut, Variable Speed Adjustment Stud (Optional)
14	HOUSING, CYLINDER AIR - LEFT		
	134D1986	1	Spec A and B
	134D2141	1	Begin Spec C
	HOUSING, BLOWER		
15	134C1988	1	Key 1
16	134C1992	1	Key 2
16	134C2119	1	Vacu-Flo Cooled Engines - Optional
16	134C2264	1	Engines With Optional Top Mounted Control
17	HOUSING, CYLINDER AIR - RIGHT		
	134B1990	1	Key 1 - Spec A and B
	134B2142	1	Key 1 - Begin Spec C
	134B1997	1	Key 2 - Spec A and B
	134B2143	1	Key 2 - Begin Spec C
18	134B2149	1	Scroll, Air - Vacu-Flo Cooled Engines - Optional
19	517-21	2	Plug, Dot Button (7/8") - Air Scroll - Vacu-Flo Cooled Engines - Optional

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	HOSE, OIL DRAIN		
20	503A391	1	Early Models
20A	122B345	1	Later Models
21	517-35	1	Plug, Dot Button (1-1/16") - Vacu-Flo Cooled Engines - Optional
22	134B2251	1	Panel & Support, Control - Optional
23	150B1323	1	Slide, Governor Control - Opt.
24	150A1324	1	Knob, Governor Control - Opt.
25	150A1325	1	Stud, Governor Control - Opt.

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
26	518-305	1	Ring, Retainer
27	800-4	1	Screw (1/4-20 x 5/8")
28	526-18	2	Washer, Flat
29	851-21	1	Washer, Tension
30	870-259	1	Nut, Lock (1/4-20)
31	800-5	1	Screw (1/4-20 x 3/4")
32	526-15	2	Washer, Flat (1/4)
33	870-65	1	Nut, Hex (1/4-20)
34	815-199	2	Screw (10-32 x 5/16")
35	870-131	2	Nut & Washer (10-32)

ALTERNATOR GROUP (OPTIONAL EQUIPMENT)

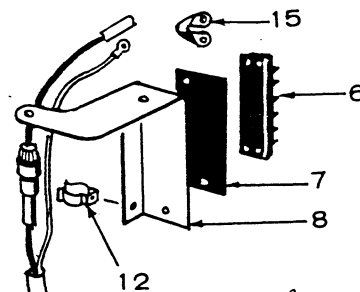
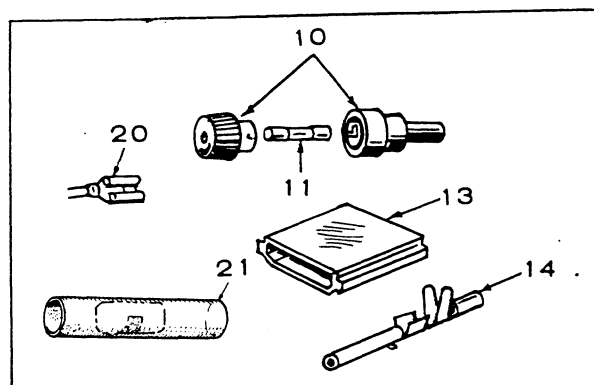


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	191-573	1	★Alternator, 12 Volt, 35 Amp. Less Reg. & Pulley
2	191-574	1	Regulator, Voltage
3	191C623	1	Pulley, Alternator
4	BRACKET, ALTERNATOR MOUNTING		
	191B537	1	Key 2
	191B811	1	Vacu-Flo Cooled Engines
5	191C840	1	Bracket, Stiffener - Vacu-Flo Cooled Engines
6	191A535	1	Bracket, Alternator Adjusting
7	511-51	1	Belt, Alternator Drive
8	800-94	1	Screw (1/2-13 x 2") - Alternator Mounting
9	862-16	1	Nut, Hex (1/2-13) - Alternator Mounting

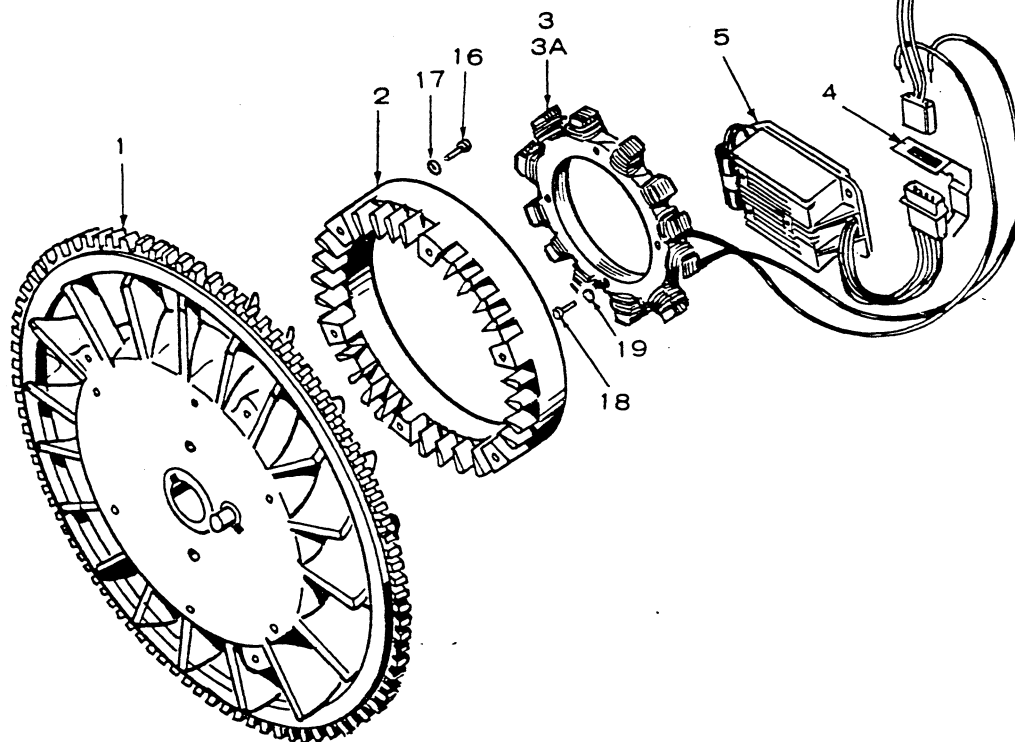
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	PULLEY, ALTERNATOR DRIVE		
10	191C848	1	Key 2 - Spec A Only
10	191C812	1	Key 2 - Begin Spec B
10A	191C134	1	Vacu-Flo Cooled Engines
11	191P659	1	Brush & Holder Assembly (Alternator)
12	191P671	1	Diode Assembly, Isolation (Alternator)
13	191P662-	1	Diode Assembly, Rectifier- Negative (Alternator)
14	191P661	1	Diode Assembly, Rectifier- Positive (Alternator)

★ - For components not listed, contact your nearest Motorola Dealer or Motorola Automotive Products, Inc., 9401 W. Grand Ave., Franklin Park, Illinois 60131.

CHARGING ALTERNATOR GROUP- 12 V. (OPTIONAL EQUIPMENT)

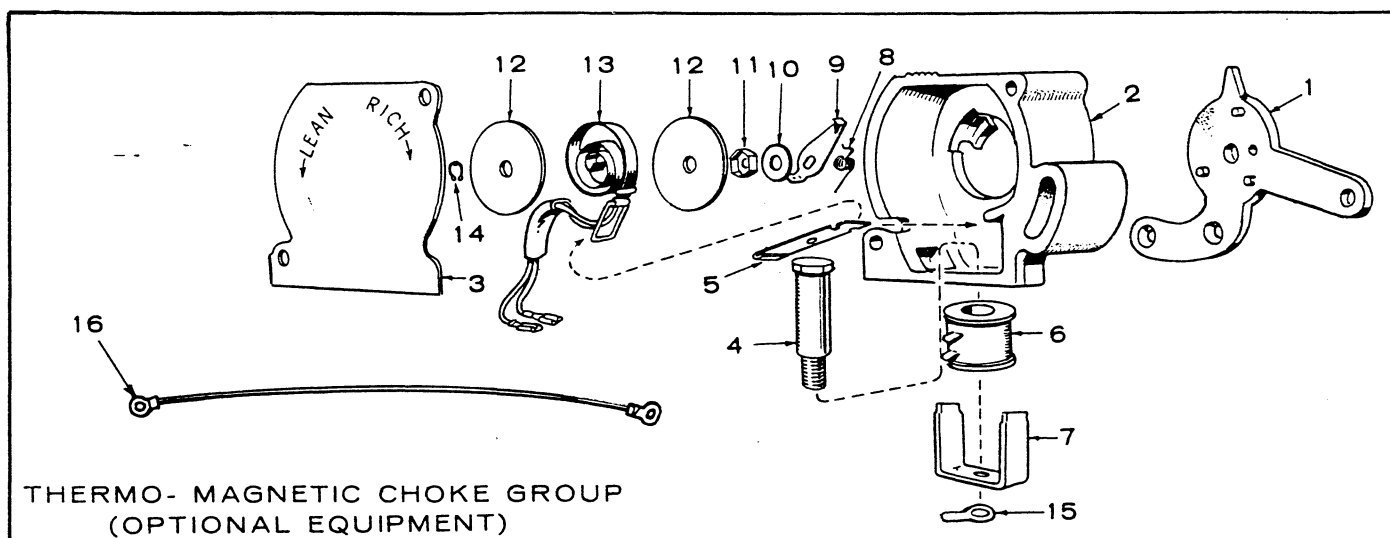


#1/6 wire?



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	FLYWHEEL - INCLUDES RING GEAR (Also listed in Crankshaft and Flywheel Group)		
	134B2071	1	Spec A Only
	134B1895	1	Begin Spec B
2	191C400	1	Rotor
3	191B740	1	Stator Assembly (Includes Parts Marked *)
3A	191B724	1	*Stator Only
4	332A1410	1	Bracket, Connector Mounting
5	305C471	1	Regulator - Rectifier Assembly
6	332A604	1	Block, Terminal (5-Place)
7	332A1273	1	Strip, Marker
8	301B3230	1	Bracket, Terminal Block Mtg.

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
10	321P165	1	*Holder Assembly, Fuse
11	321-162	1	*Fuse - 30 Amp
12	321B169	1	Clip, Fuse Holder Mounting
13	323P759	1	*Connector, Socket Housing
14	323C488	4	*Socket, Connector
15	337A88	1	Jumper, Terminal Block
16	812-156	6	Screw (1/4-20 x 1-1/2") - Rotor to Flywheel
17	850-40	6	Washer, Lock (1/4)
18	813-108	3	Screw (10-32 x 1-1/2") - Stator to Gearcover
19	850-30	3	Washer, Lock (#10)
20	332P529	1	*Terminal, Faston
21	332-556	1	*Connector, Faston

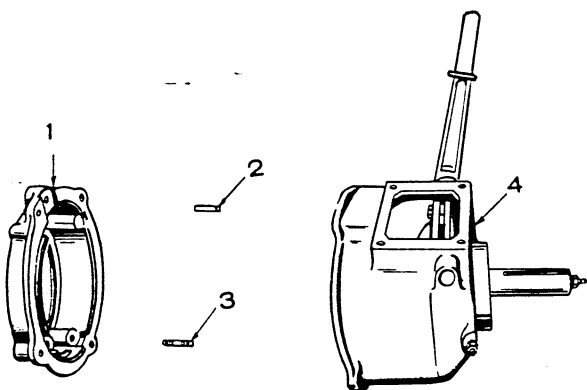


THERMO- MAGNETIC CHOKE GROUP
(OPTIONAL EQUIPMENT)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	153K429	1	Replacement Kit (Includes complete Choke- less leads)
1	153C385	1	Plate, Mounting
2	153D386	1	Body
3	153C389	1	Cover
4	153B391	1	Core, Solenoid
5	153A395	1	Armature
6	307B801	1	Coil, Solenoid Assembly
7	153B392	1	Frame, Solenoid
8	153B387	1	Spring
9	153B390	1	Lever, Thermostat

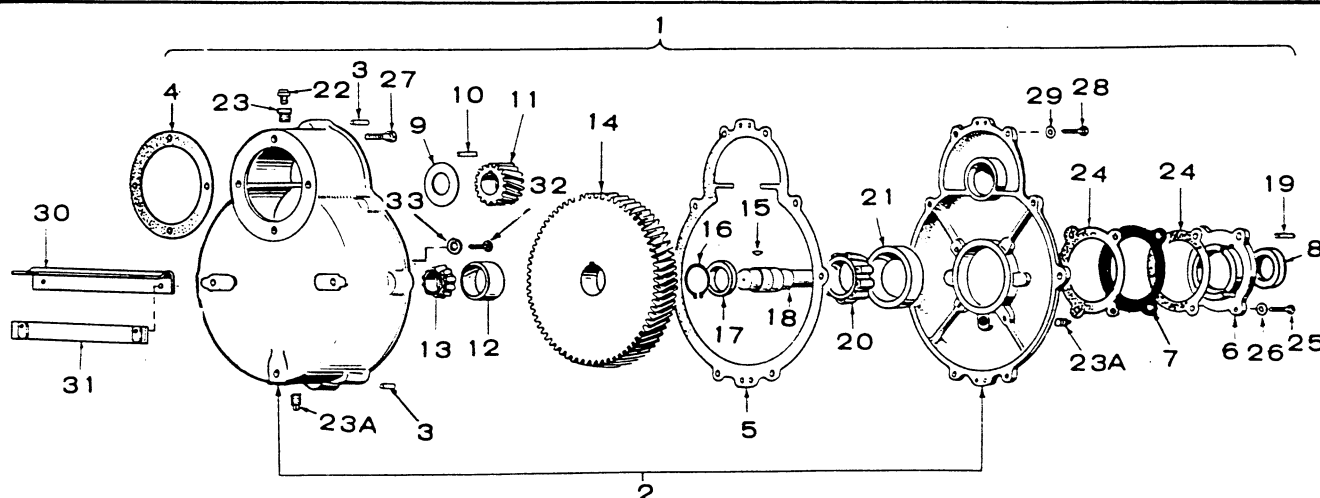
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
10	526-18	1	Washer (17/64" I.D. x 5/8" O.D. x 1/16")
11	870-134	1	Palnut (1/4-20)
12	153A399	2	Insulator
13	153B400	1	Heater Assembly
14	518-129	1	Ring, Retaining
15	332A876	1	Terminal, Ground
16	LEAD, CHOKE		
	336A1550	1	Choke to Ground
	336A1549	1	Choke Solenoid Ground

CLUTCH GROUP (OPTIONAL EQUIPMENT)



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	190D171	1	Adapter, Clutch to Engine
2	515A196	1	Key, Clutch
3	STUD, CLUTCH HOUSING TO ENGINE		
	520A738	1	3/8-16 x 4"
	520A739	2	3/8-16 x 3"
4	190D288	1	*Clutch Assembly
	190K289	1	Clutch Kit - Includes complete Clutch, Adapter, Mounting Hardware & Instructions

* For component parts, check clutch nameplate and order by description from your nearest Rockford Dealer.



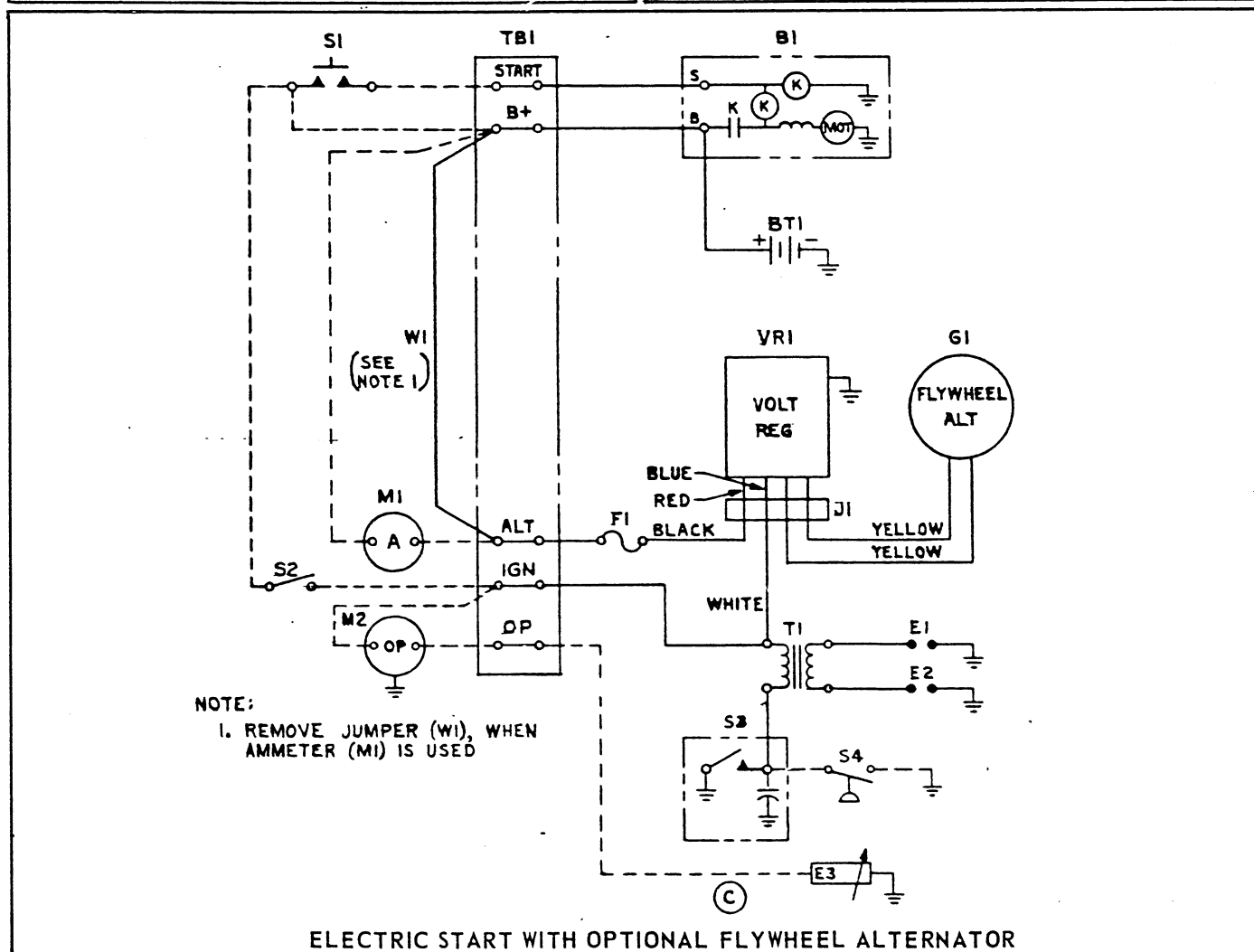
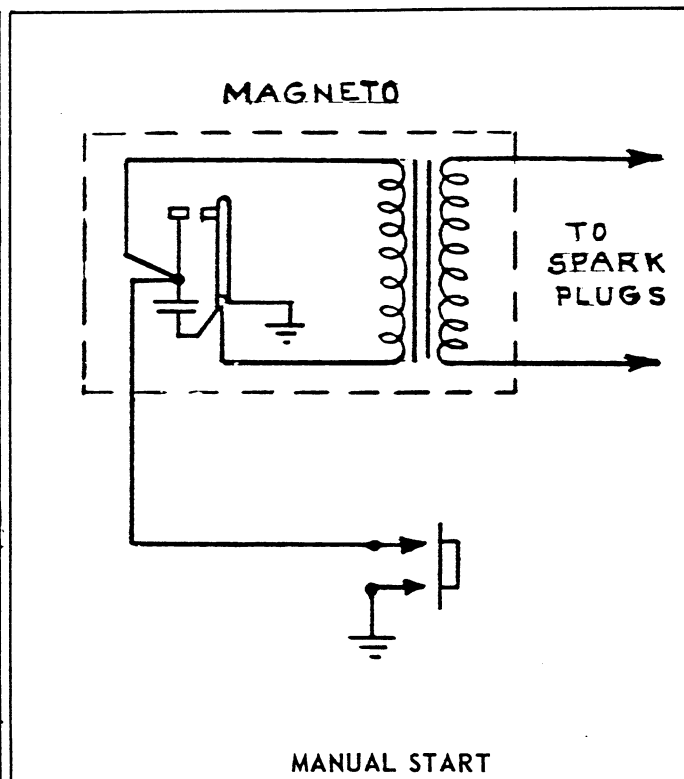
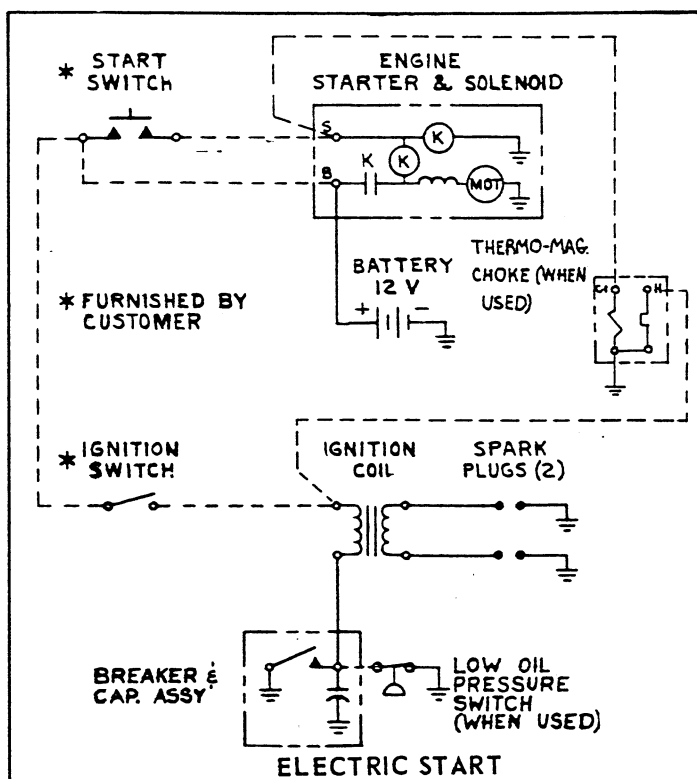
REDUCTION GEAR GROUP (OPTIONAL EQUIPMENT)

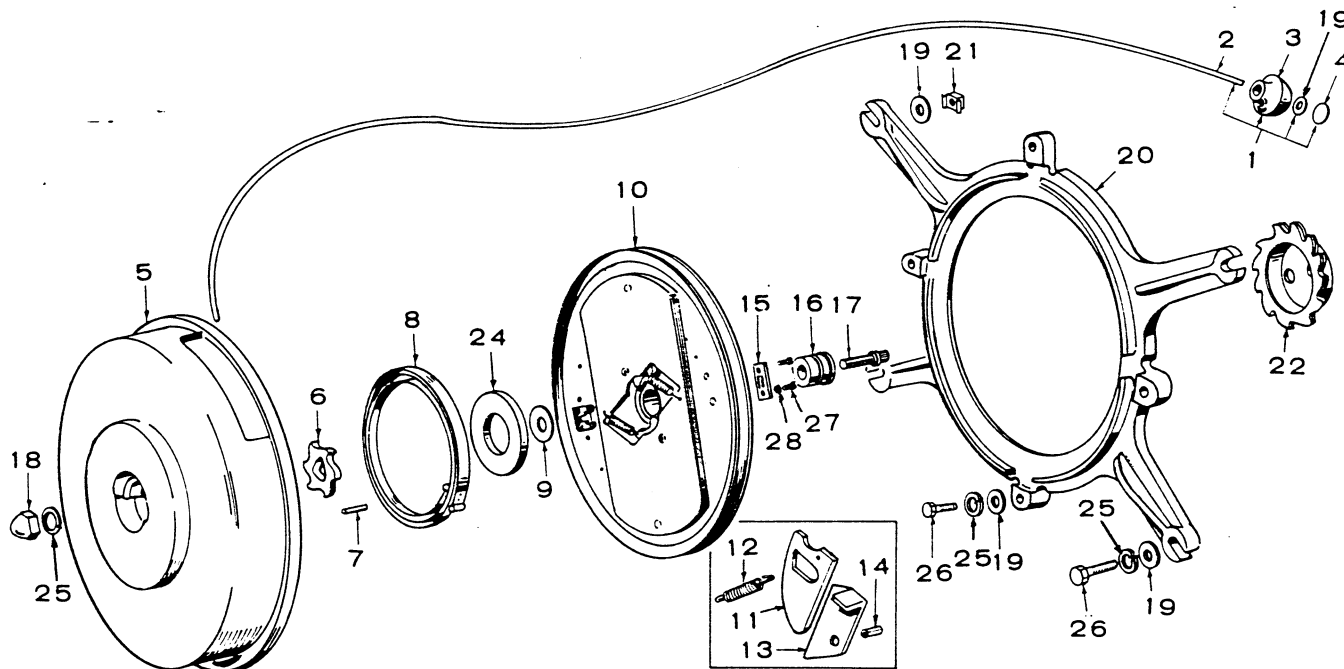
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	190C290	1	Reduction Gear Assembly (4-1) Complete
2	190A300	1	Housing - Includes Cover (Also Order 2 #516A12 Pins)
3	516A12	2	Pin, Dowel, Cover to Housing
4	190A20	1	Gasket, Housing to Engine
5	190B21	1	Gasket, Cover to Housing
6	190B16	1	Plate, Bearing Retainer
7	190A115	1	Shim Set, End-Play Adjustment (1 each .005", .009", .012", .016", .020", .025")
8	509-16	1	Seal, Oil, Retainer Plate
9	190A195	1	Washer, Pinion Gear
10	515A142	1	Key, Pinion Gear
11	190A191	1	Gear, Pinion
12	510-22	1	Cup, Roller Bearing, Engine End
13	510-21	1	Cone, Roller Bearing, Engine End
14	190B190	1	Gear, Driven
15	515A159	1	Key, Driven Gear
16	518-13	1	Ring, Snap, Retainer
17	190A202	1	Spacer, Bearing
18	190A192	1	Shaft, Take-Off
19	515A103	1	Key, Take-Off Shaft

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
20	510-23	1	Cone, Roller Bearing, Take-off End
21	510-24	1	Cup, Roller Bearing, Take-off End
22	518P172	1	Vent
23	505-7	1	Bushing, Reducer (1/4 x 1/8)
23A	505-54	2	Plug, Pipe (1/4)
24	190A306	2	Gasket, Bearing Plate to Housing
25	800-7	4	Screw (1/4-20 x 1") - Bearing Plate to Housing
26	526-63	4	Washer, Flat (Copper)
27	805-9	4	Bolt, Place (5/16-18 x 1") - Housing to Engine
28	800-28	8	Screw (5/16-18 x 1") - Cover to Housing
29	526-65	8	Washer, Flat (Copper)
30	190B297	1	Support, Housing Assembly
31	190A298	1	Fastener, Support - Housing Assembly
32	800-26	2	Screw (5/16-18 x 3/4") - Housing to Support
33	526-65	2	Washer, Flat (Copper) - Housing to Support

WIRING DIAGRAMS

The wiring diagrams on the following page are typical and apply only to standard NH series engines. Wiring diagrams for special models are available on request from the factory: send engine model, spec and serial numbers with the request.



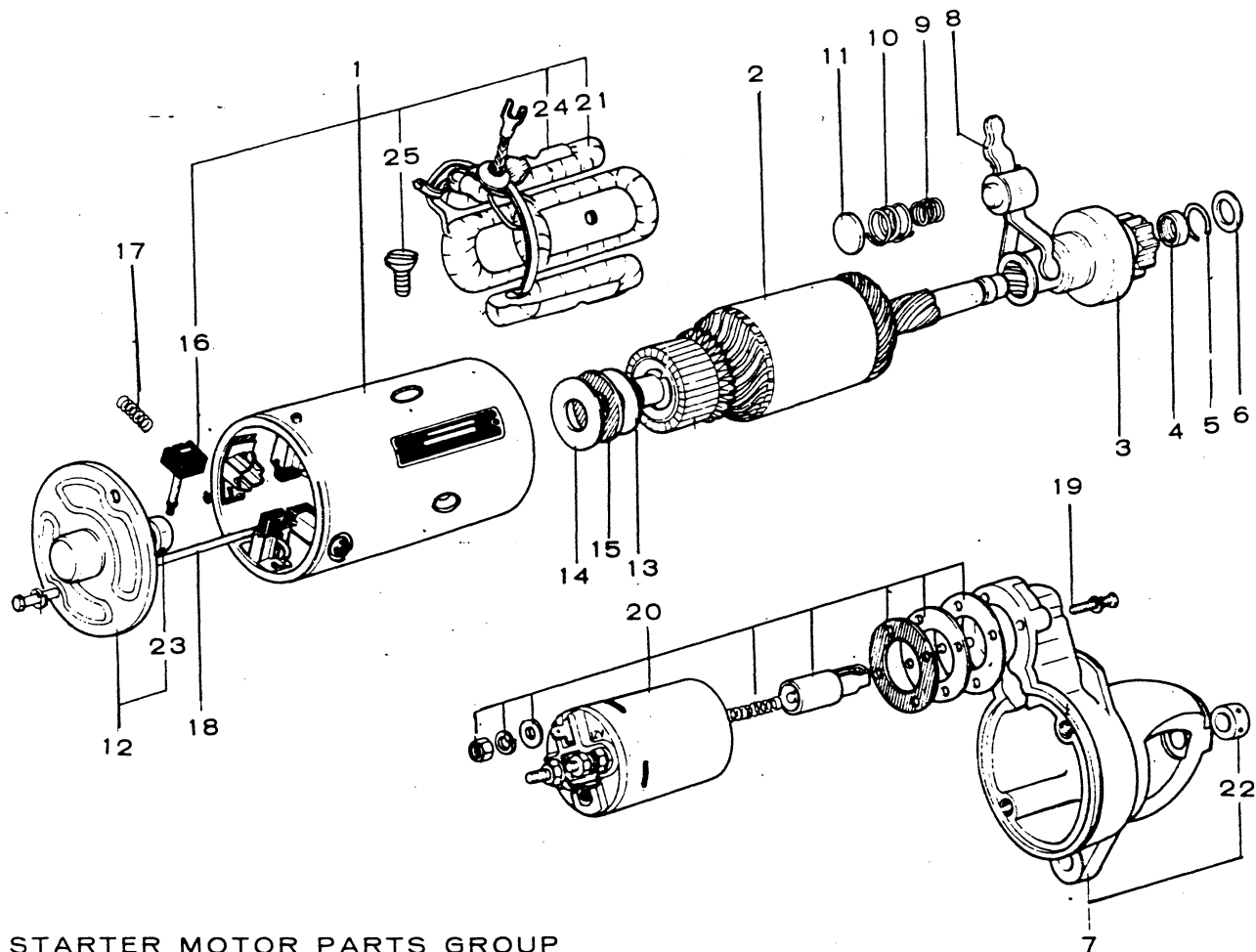


READI-PULL STARTER GROUP (OPTIONAL EQUIPMENT)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	192K325	1	Starter Kit, Complete - Includes Mounting Ring & Ratchet Wheel
1	192A45	1	Rope & Grip Assembly
2	192A43	1	Rope, Starter, Less Grip (83'')
3	192A44	1	Grip, Starter Rope - Rubber
4	517A25	1	Plug, Starter Rope Grip
5	192C152	1	Cover, Starter
6	192A153	1	Wheel, Cog-Anti-Backlash
7	516-138	1	Pin (3/16 x 5/8'') Recoil Spring
8	192A39	1	Spring, Recoil
9	526A123	1	Washer, Thrust (Sheave Bushing to Cover)
10	192B180	1	Sheave, Rope (Includes Parts Marked *)
11	192A172	2	*Pawl
12	192A165	2	*Spring, Pawl
13	192A168	2	*Arm, Ratchet
14	516-110	4	*Pin, Roll (5/16 x 1/2'') - (2) Ratchet Arm, (2) Pawl
15	192A167	1	*Clamp, Rope
16	192A163	1	Bearing, Sheave Hub (Bronze)
17	192A323	1	Capscrew (3/8-16 x 1-1/2'')
18	870-138	1	Nut, Bushing to Cover Screw

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
19	WASHER, FLAT		
	526A180	4	Starter to Mounting Ring
	526A169	1	Starter Rope Grip
	526-130	4	Starter Ring to Blower Housing (1/16'' Thick)
	526-158	4	Starter Ring to Blower Housing (1/8'' Thick)
20	192C186	1	Ring, Starter to Blower Housing Mounting
21	870-110	4	Nut, Speed Grip, Starter Ring to Blower Housing
22	192B309	1	Wheel, Ratchet
24	526A168	1	Washer, Recoil Spring Retainer
25	WASHER, LOCK		
	850-50	1	Cover Nut
	850-40	4	Starter Ring to Blower Housing
	850-40	4	Starter to Mounting Ring
26	SCREW, HEX CAP		
	800-7	4	Starter Ring to Blower Housing
	815-137	4	Starter to Mounting Ring
27	815-137	2	*Screw, Hex Cap - Rope Clamp Mounting
28	526-15	2	*Washer, Flat - Rope Clamp Mounting

* - Included in #192B180 Rope Sheave Assembly.



STARTER MOTOR PARTS GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	191D734	1	Motor Assembly, Starting
1	191-742	1	Yoke Assembly (Frame) - Includes Parts Marked *
2	191-743	1	Armature
3	191-744	1	Clutch, Starter
4	191-745	1	Stop, Pinion
5	191-746	1	Ring
6	191-747	1	Washer, Plain
7	191-748	1	Bracket Assembly, Front
8	191-749	1	Lever Assembly
9	191-750	1	Spring, Lever
10	191-751	1	Spring, Lever
11	191-752	1	Holder, Spring
12	191-753	1	Bracket Assembly, Rear
13	191-754	1	Washer, Plain

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
14	191-755	1	Washer, Plain
15	191-756	1	Washer, Insulator
16	191-757	4	*Brush
17	191-758	4	Spring, Brush
18	191-759	2	Bolt, Through
19	191-760	3	Screw, Machine P.H.
20	191-761	1	Switch Assembly, Solenoid
21	191-762	1	*Coil Assembly, Field
22	191-763	1	Bearing, Front
23	191-764	1	Bearing, Rear
24	191-765	4	*Pole Shoe
25	191-766	4	*Screw, Pan Head

* Included in Yoke Assembly.

SERVICE KITS AND MISCELLANEOUS

NOTE: For other kits, refer to the group for the part in question.

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	98C1807	1	Decal Kit
	168K113	1	Gasket Kit, Complete Engine
	168K115	1	Gasket Kit, Carbon Removal
	160K836	1	Ignition Tune-up Kit
	522K254	1	Overhaul Kit, Engine
	525P137	1	Paint, Green Touch-up Enamel - 16 Oz. Pressurized Can

CUSTOMER SERVICES

OWNER'S WARRANTY SERVICE -
ENGINE DRIVEN ELECTRIC GENERATOR SETS,
SEPARATE GENERATORS, INDUSTRIAL ENGINES

QUALITY OF PRODUCT

Onan products are engineered and designed to perform as stated on product nameplate and published specification. With proper installation and operation, regular maintenance and periodic repair service, the equipment will provide reliable service.

GENERAL WARRANTY PRACTICES

All Onan-manufactured engine-driven electric generator sets, separate generators, and industrial engines are sold with a full one-year warranty. This warranty is issued only to the original user and promises satisfactory performance of the product when properly installed, serviced, and operated under normal conditions, according to the manufacturer's instructions. The text of the Onan published warranty appears in the Onan Operator's Manual sent with the product.

Warranty Registration: A Warranty Registration card accompanies each Onan Product. This card must be properly filled out and returned to the Onan Factory in order to qualify for warranty consideration as covered in this bulletin. When requesting warranty repair work you must provide the purchase date, Onan model, and serial number of the equipment.

Warranty Authorization: Warranty service must be performed by Onan Factory or Onan Authorized Distributors or their Approved and Registered Service Dealers. A complete listing of these Onan Authorized Parts and Service Centers is provided in our brochure F-115, a copy of which is supplied with each Onan Product. These Onan Authorized Service Centers have trained service personnel, parts stock, and the necessary facilities and tools for the service and repair of Onan equipment.

Material Allowances: Onan will allow credit or furnish free of charge to the Onan Authorized Service Station or his Approved Service Dealer, all genuine Onan parts used in a warranty repair of these products which fail to perform as warranted.

Labor Allowance: Onan will allow warranty repair credit to the Onan Authorized Parts and Service Center and his Approved Dealer at straight time labor when the cause of failure is determined to be defective material or factory workmanship. This labor allowance will be based on the factory's standard time schedule of published flat rate labor allowances, or, otherwise a time judged reasonable by the factory. Repair work not covered by warranty will be charged to the owner. The Onan's Warranty practice does not provide for allowance of expenses such as start-up charges, communication charges, transportation charges, travel time and/or mileage, unit removal or installation expense, cost of fuel, oil, normal maintenance adjustments, tune-up adjustments or parts maintenance items, and does not cover incidental or consequential damages.

Administration: Warranty of Onan Products is administered through Onan Authorized Distributors in whose territory the equipment is located. These Distributors and their Approved or Registered Onan Service Dealers are authorized to make settlement of all customer warranty claims within the limits of the manufacturer's warranty policy as described herein.

Onan reserves the right to change warranty practices without prior notice.

MAINTENANCE

A Planned Preventive Maintenance Program is extremely important if you are to receive efficient operation and long service life from your Onan unit. Neglecting routine maintenance can result in premature failure or permanent damage to your equipment. The Onan Operator's Manual sent with the product contains recommended maintenance schedules and procedures.

Maintenance is divided into two categories:

1. Operator Maintenance performed by the operator.
2. Critical Maintenance performed only by qualified service personnel.

Regular maintenance will help you avoid sudden and costly repairs in the future. Adequate evidence of this scheduled maintenance must be offered when applying for a warranty claim.

INSTALLATION

Installation is extremely important and all Onan Products should be installed in accordance with the manufacturer's recommendations. If the owner experiences any difficulty with such items as mounting, ventilation, exhaust location, fuel lines, wiring, etc., he should immediately contact the company from whom he purchased the equipment so that corrective action can be taken. Although the Onan Authorized Distributor and his Approved or Registered Service Dealers may be able to remedy certain installation difficulties, such repair work is not considered Onan warranty and there will be a charge for this service.

Onan

Minneapolis, Minnesota 55432

MSS-22B

Replaces 23B054 and MSS-22A . . .

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